THE MODEL ENGINEER

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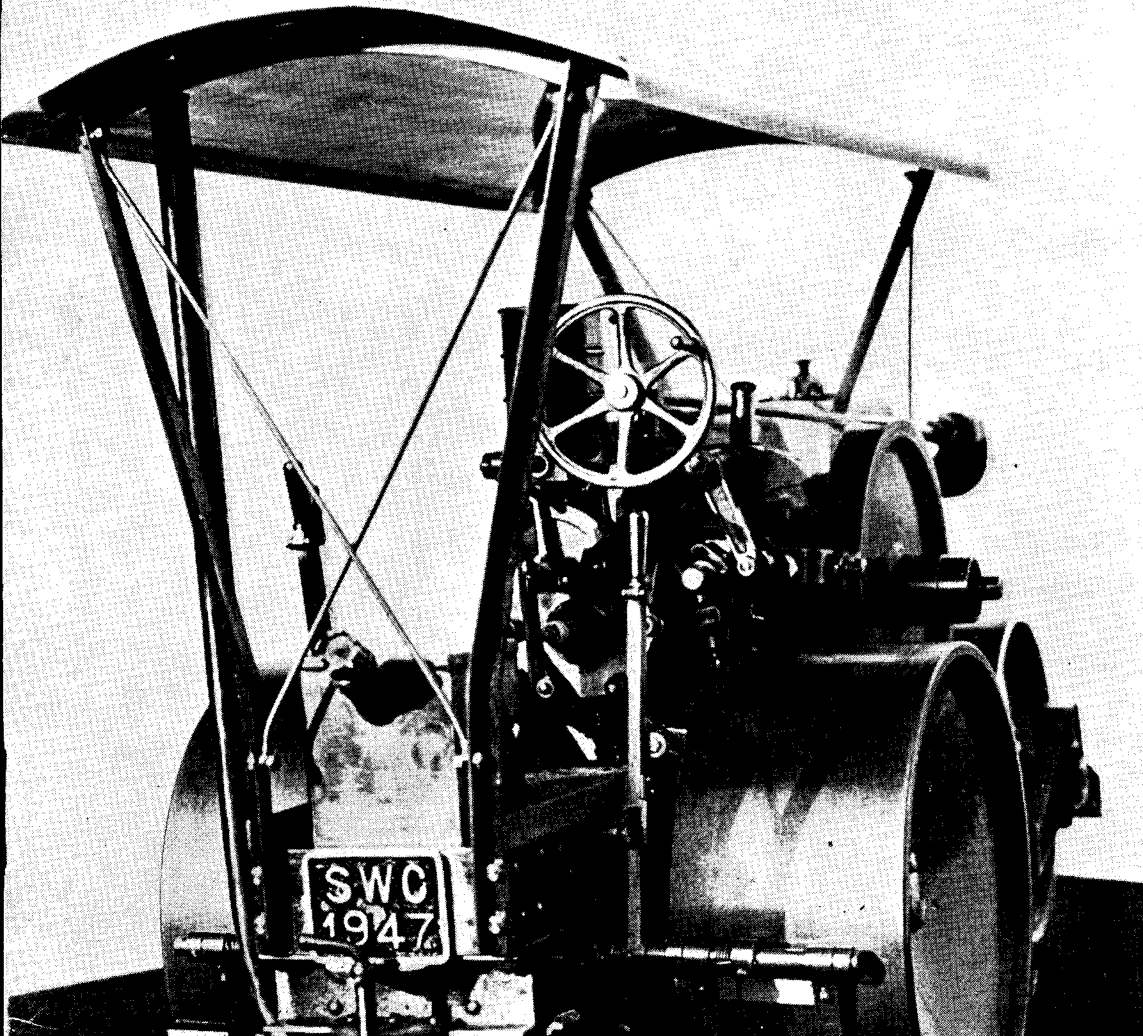
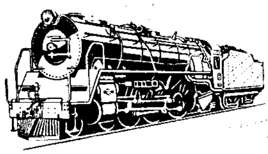


The MODEL ENGINEER

Percival Marshall & Co. Ltd., 23, Great Queen St., London, W.C.2



12 JUNE 1947 VOL. 96. NO. 2403

SMOKE RINGS

Our Cover Picture

AMONG the many popular model designs which have appeared in THE MODEL ENGINEER in the past, that of the Aveling Type D.X. I.C.-engine driven road roller has appealed equally to lovers of handsome scale models, and those whose tastes favour modern developments in engineering design. This rear view of one of the road rollers made to the above design by Mr. S. W. Coulter, of Belfast, conveys an impression of the realistic appearance of the model. Two views of this model in course of construction appeared in the issue of THE MODEL ENGINEER dated January 16th last, and some further pictures showing later stages of development will appear shortly.

South Coast Miniature Railways

I AM interested to hear that the attractions of the South Coast are to be enhanced by the addition of some more passenger tracks for the entertainment of the public. One of these is at the Lido in Southsea, while at Weymouth there will be two tracks, one in 7¼-in. gauge on the Channel Steamer Pier and the other in 10¼-in. gauge at the Radipole Lake. All these tracks will be engined and operated by David Curwen Ltd., of Baydon, Wilts., who are specialising in large scale locomotive construction. The track at Radipole Lake is at present ¼-mile in length, but it is hoped to extend it in a later season. I understand that the Weymouth Corporation have been most helpful and enthusiastic. It looks as though no well-organised seaside resort will in the near future be regarded as complete without its miniature railway.

A Tribute from Salt Lake City

MR. JOHN H. BRYAN, an English engineer long resident in Salt Lake City, Utah, sends me a renewal of his MODEL ENGINEER subscription and writes these words :—"The arrival of the magazine is always the occasion for rejoicing; its contents, always eminently sane, seem to portray anew the commonsense and extremely practical nature of the British people. Over here one is continually reading in the daily press that Britain and her Empire are finished, that without the financial and moral assistance of the United States, she and her Empire would collapse like a pricked balloon, and that the U.S. has a monopoly of inventiveness." I do not think we need attach much importance to this energetic waving of the star-spangled banner by the American Press. If I were writing in another type of journal I could formulate a very effective reply, but THE MODEL ENGINEER is not quite the place for international "scrapping" of this kind. What, however, I do think is rather nice is Mr. Bryan's recognition of the sanity of purpose and the practical demonstration of ability he finds in the pages of THE MODEL ENGINEER. This compliment I pass on with pleasure to our many contributors and correspondents whose writings and whose workshop achievements make our journal outstanding as a platform of handicraft, skill, ingenuity, and mutual help. Every issue of THE MODEL ENGINEER is, in its modest way, an effective answer to the selfishly dictated criticism that the old country is "down and out." Perhaps the wish is father to the thought, but model engineers know and think differently. Long may they do so.

An Indian Cup for the "M.E." Exhibition

A VERY pleasing letter has reached me from Mr. M. P. Polson, the enthusiastic and generous Chairman of the Bombay Society of Model Engineers. He writes :—" You very well know my love for model engineering and all I am trying to do in its interest on this side of the world. As I would like to encourage a model engineer, no matter in which part of the world he existed, I would like to donate, in my personal humble capacity, a Cup to be won outright in any section of your Exhibition you may decide upon. I admire the good work you are doing, and my offer is but a very humble tribute to assist you in what little way I can." I most sincerely thank Mr. Polson for his generous offer, which I am pleased to accept in the spirit in which it is made. I am sure it will be much appreciated not only by the fortunate winner, but by model engineers in this country generally as a very practical gesture of goodwill from the brotherhood overseas. The details of the destination of the Cup at the Exhibition will be announced later. It is pleasing to think that while this country is extending the fullest possible sympathy and assistance to India in her difficulties, this return wavelet of friendship should be extended by an Indian model engineer to British model engineers.

"M.E." Exhibition Stewards

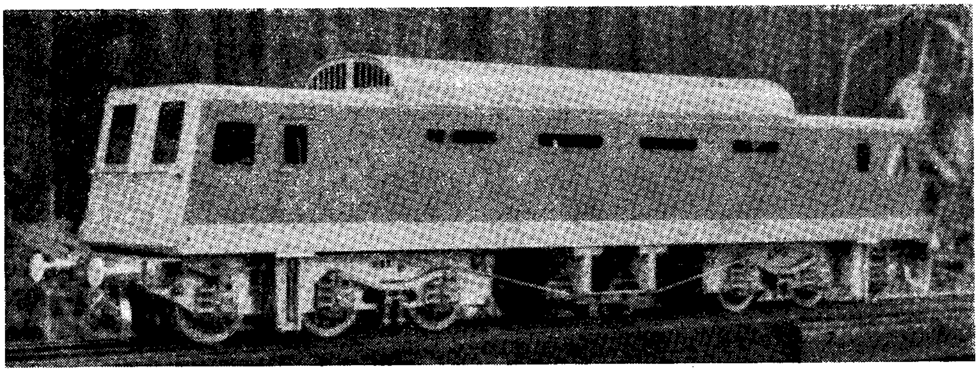
WE shall probably require to appoint one or two additional stewards for service at the "Model Engineer" Exhibition in unpacking, arranging, and generally supervising the competition and loan models. Whole-time service for the period of the Exhibition would be necessary, and suitable remuneration would be paid. While actual model-making skill is not necessary, it is desirable that applicants should have a general knowledge of model engineering to enable them to answer visitors' enquiries, and the ability to handle one or two simple tools. The dates would be from August 19th to September 2nd. Offers should be addressed to : The "M.E." Exhibition Manager, 23, Great Queen Street, London, W.C.2.

The Attraction of Model Car Racing

I NOTICE in an American motoring journal that in the States some of the roadside restaurants and hotels are installing model race-car tracks in their grounds as an attraction to visitors. Over here there are several instances of model passenger locomotive tracks being similarly installed, and this is a movement likely to grow, as the miniature steam railway is a perpetual source of interest and delight. It is quite possible that model car racing will be another addition to the menu of the countryside-caterer. The same American journal reports a conversation beween two enthusiasts, one of whom asks the other : "Where the heck did this racing business start, anyway ?" "Didn't you know ?" the other replied, " 'twas those fool Romans tearing around in their chariots that started the idea."

A Fine Electric Locomotive Model

OUR photograph on this page gives an excellent impression of the fine $3\frac{1}{2}$-in. gauge electric locomotive built by Mr. W. F. A. Way, of Norwich, which gained the "Gill-Knight" Prize at the 1946 "Model Engineer" Exhibition. Intended for passenger-hauling, it is a powerful design, and Exhibition visitors will doubtless remember the high quality of the craftsmanship shown in its construction. In honour of Mr. F. L. Gill-Knight, who has done so much to stimulate interest in model electric traction, the locomotive is to bear his name.



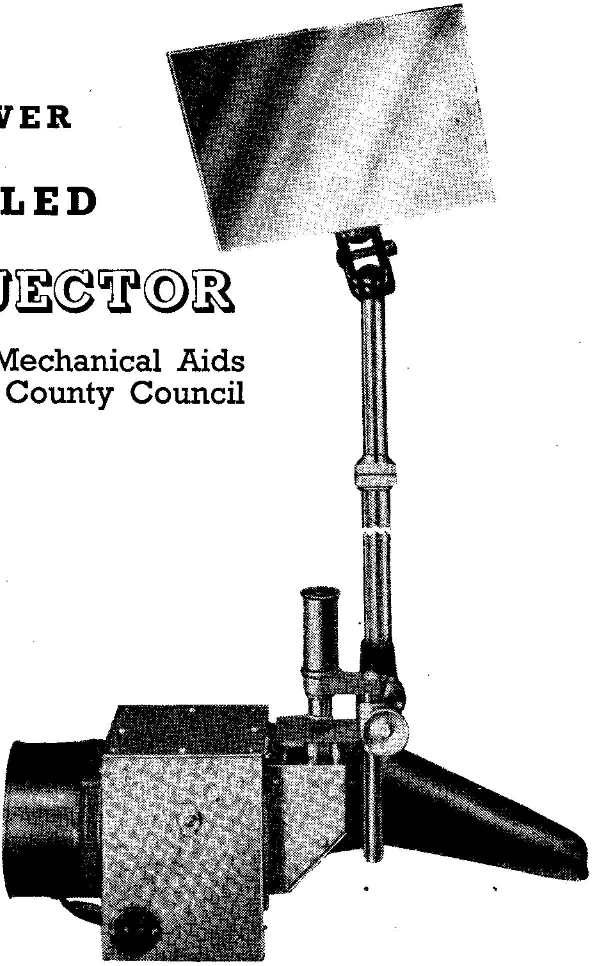
Mr. W. F. A. Way's prize-winning $3\frac{1}{2}$-in. gauge electric locomotive built for passenger-hauling

Wanted—a Ship Modeller

A WELL-KNOWN museum in the London area requires the services of a competent model maker for the restoration and repair of some of its valuable period ship models. Applicants should not only be good craftsmen, but should possess a knowledge of accurate period detail in regard to rigging and constructive detail. Any replies addressed to me, will be forwarded to the Director of the museum concerned.

Percival Marshall

A HIGH POWER AIR-COOLED MICRO-PROJECTOR

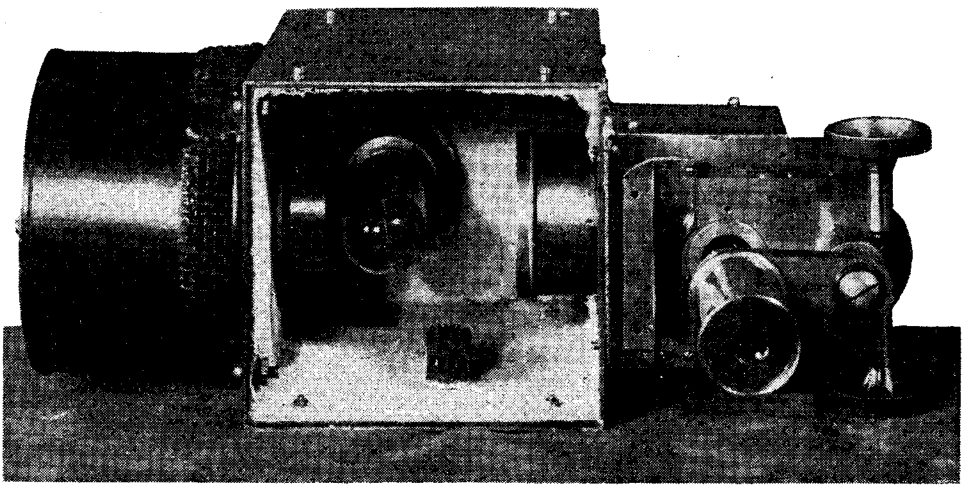


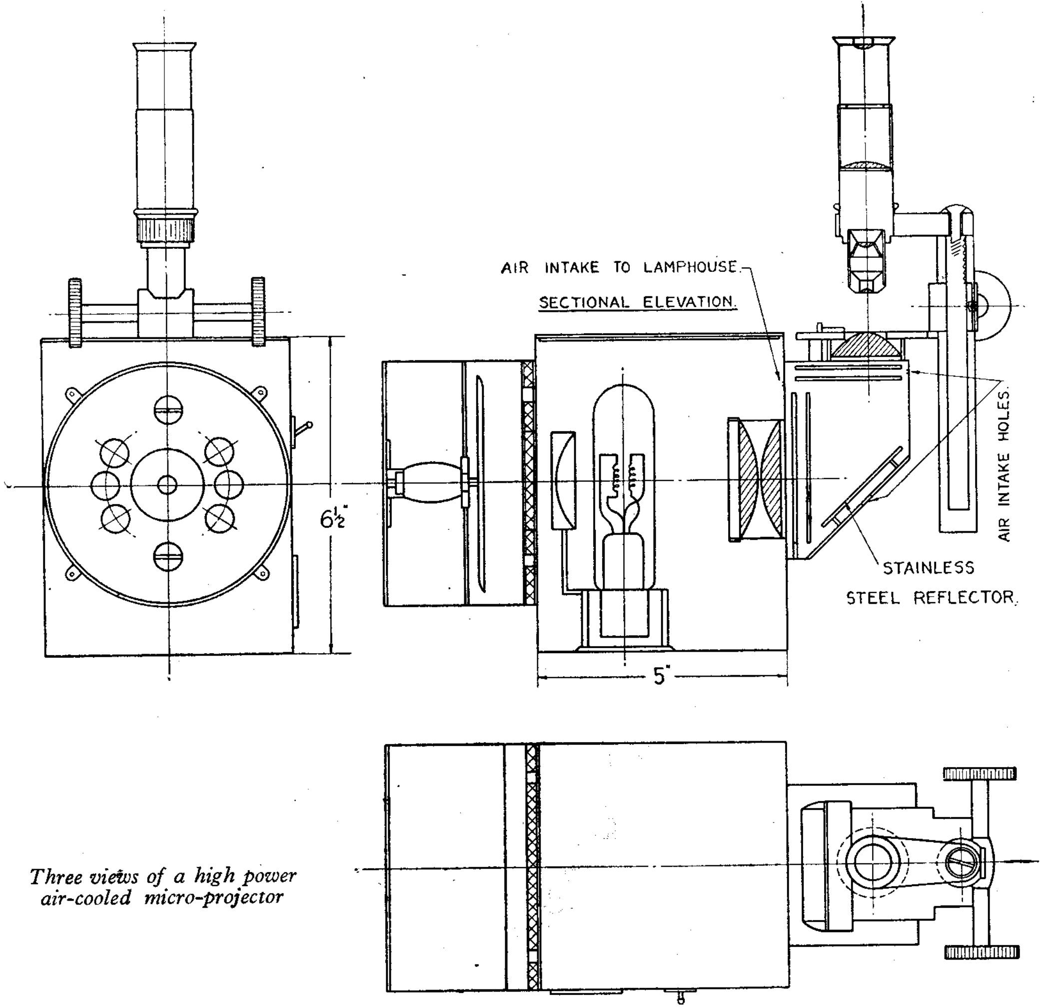
by V. H. AUSTIN, Late Mechanical Aids Supervisor to The Herts. County Council

THIS Micro-Projector was originally designed for educational purposes in the classroom, where, to obtain maximum interest it is desirable to have the object under projection brilliantly projected upon the screen, representing a great advance over many of the medium-priced micro-projectors with their meagre light output operated under the semi-dark conditions usually found in the normal classroom.

In the writer's opinion, the success of any optical projector depends upon an adequate light source with an efficient condenser system for the collection of available light. After some experiment the present layout was evolved with the sub-stage horizontally disposed, allowing ease of manipulation to the object being projected.

The projection lamp is a 110-volt 500-watt bi-plane filament type, normally used in sub-standard film projectors. As these lamps have to





Three views of a high power air-cooled micro-projector

be used in conjunction with force draft ventilation, a small displacement fan is fitted to the rear of the lamp house ; the air inlet taking place through the sub-stage condenser and diverting mirror housing in which are also housed a series of glass plates so arranged that air must pass over them before reaching the lamp house. This will be seen from the accompanying drawing : thus, not only is adequate cooling of the projection lamp obtained, but the arrangement also affords a certain amount of secondary cooling to the actual light source.

For normal screen working a small correcting mirror is fitted to the lens tunnel, but as it was desired to obtain fine adjustment of the magnification, a larger mirror was fitted to an adjustable stand, projecting the object to be inspected on to a drawing-board used at the side of the projector, making a very compact lay-out ; this will be seen from the accompanying photograph.

Apart from the objective rack and pinion and the lens mountings, the whole structure is easily fabricated from 16 S.W.G. sheet brass, the corners being V'ed and silver-soldered. The lamp house has a close fitting lid, and a detachable cover is fitted to the sub-stage condenser housing, giving access to the stainless-steel mirror for adjusting purposes.

A pre-focus projection lamp and holder is fitted, making replacement of the projection lamp a fool-proof operation after the initial set-up.

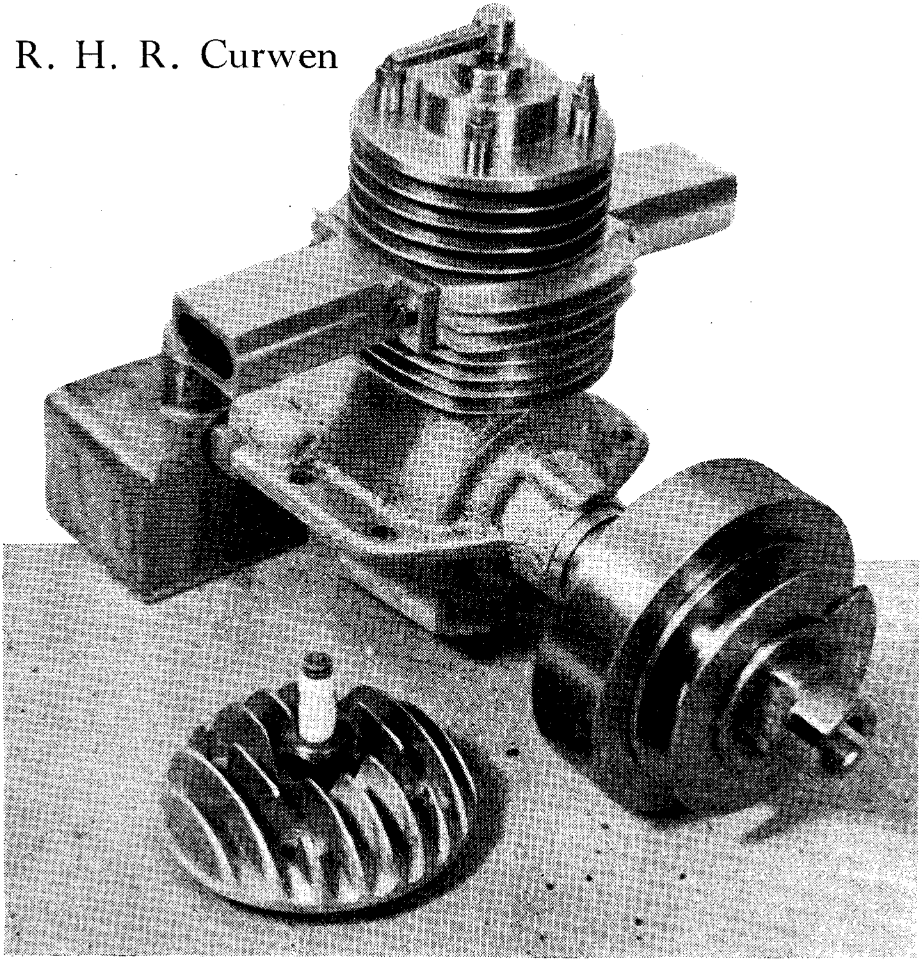
The motor and projection lamp requiring 110 volts, an auto transformer is used if the A.C. mains are of a higher voltage.

During the war years, my work and ideas were far removed from "tranquil scenes" of the classroom and my high power micro-projector was doing good work in a Government factory, being utilised for the inspection of diamond wire drawing dies during the grinding process, operating under average daylight conditions to be found therein.

PETROL OR DIESEL?

Comparative tests of the two systems using the same engine

by R. H. R. Curwen



The engine in Diesel form, with its petrol cylinder-head alongside

THE photograph shows a 5-c.c. two-stroke which has been converted from petrol to compression-ignition operation, the change-over being simply carried out by fitting a cylinder-head with integral contra piston in place of the normal head shown alongside.

The whole idea was, of course, an endeavour to obtain a true comparison of the two systems; and it seemed that this could only be done by using the self-same engine for both tests, no changes being made other than the substitution of the cylinder-head.

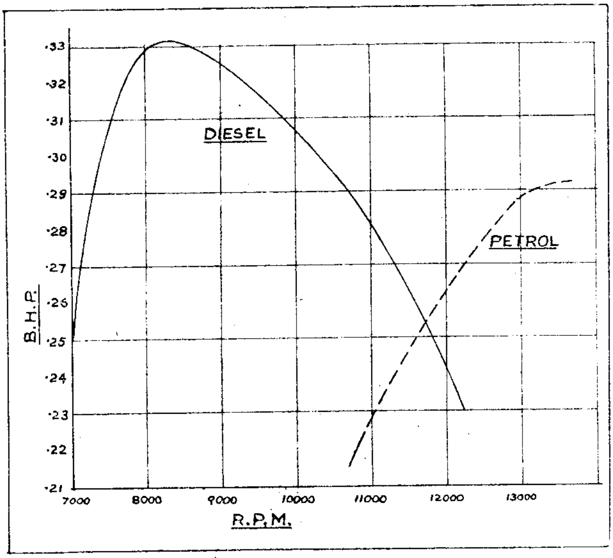
My limited experience of model C.I. two-strokes leads me to believe that their requirements as to porting and timing are identical with those of their petrol relatives.

The engine was tested in the usual way on a simple reaction-type of mounting and the b.h.p./r.p.m. curves were plotted from the results. As can be seen, the Diesel gets it by some 14 per cent. with 0.33 b.h.p. at 8,000 as compared to 0.29 at 13,000 for petrol. And the Diesel gains still further on horsepower per unit weight due to the elimination of the ignition gear.

Compression Ratio and Fuel

On petrol operation, a compression ratio of 10 to 1 was used, which best suits this particular engine when running on straight petrol, and on C.I. the ratio for best performance under load varied from 16 at 7,000 to 20 at 12,800 r.p.m. when using "Mills" fuel.

Various fuel mixtures were tried out containing petrol, diesel oil, turps. and liquid paraffin, but maximum output with these varied very little provided that the compression ratio was suitably adjusted. The "Mills" fuel appears to require a lower C/R than any other fuel so far tested.



Power curves obtained from the same engine

General Considerations

Am I now converted from petrol to C.I. engines, and have I disposed of my ignition gear and sparking plugs to my less deserving friends? Definitely not! Considerably higher performance has been obtained from a similar 5-c.c. petrol engine, and in any case ignition gear, and small magnetos in particular, are to me most interesting, if at times aggravating.

It may be of interest to mention that, contrary to popular C.I. practice, the engine used in the above tests is of large bore, namely $\frac{3}{4}$ in. × $\frac{11}{16}$ in. stroke and has ports of extremely large area.

When the conversion was first made, starting was easy and the engine had no vices; but after a few hours' running as a diesel the starting became "not so good," and an inspection of the works revealed that the cylinder was corroding badly. The ether used to this date had been of 0.720 S.G. and B.S.S. Grade, and presumably contained traces of sulphuric acid. Since re-lapping the cylinder and fitting an O.S. piston I have used ether supplied in a bottle bearing the impressive inscription—Aether Anaestheticus, Aether Purificatus B.P. 0.720 S.G.

This "British Pharmaceutical" grade is in puiity, I believe, somewhere between B.S.S. and A.R. (Analytical) grades and is, according to my friend the local chemist, free from acid. Further information on this subject would be welcome.

The engine is now undergoing track tests in an experimental car chassis and shows considerable promise, though flexibility is not comparable with that obtained on petrol.

In conclusion, I will state that in spite of the results so far obtained on the bench, I refrain from making any forecast as to the future popularity of model C.I. engines for the propulsion of racing cars and boats, and as to their possible superiority for this purpose over the well-tried petrol engine. We shall see!

Appreciation

Mr. K. N. Harris writes:—"I recently obtained a copy of *Trigonometry Made Plain*, published by Percival Marshall & Co. Ltd. I would like to express my enthusiastic appreciation of it; not only is its title admirably descriptive, but its range of practical applications is most comprehensive and set out with clarity. The book should be invaluable to the student apprentice, and it has the great merit of being really interesting and easy to read.

To model engineers who are interested in originating their own designs it should prove most useful.

I am proposing to have use made of it in the education of the engineer apprentices, for whose training I am responsible, and I would like most strongly to recommend it to the attention of all intelligent model engineers, not only for its inherent value, but as well worth reading for its intrinsic interest."

FIRE PUMPS and BOILERS

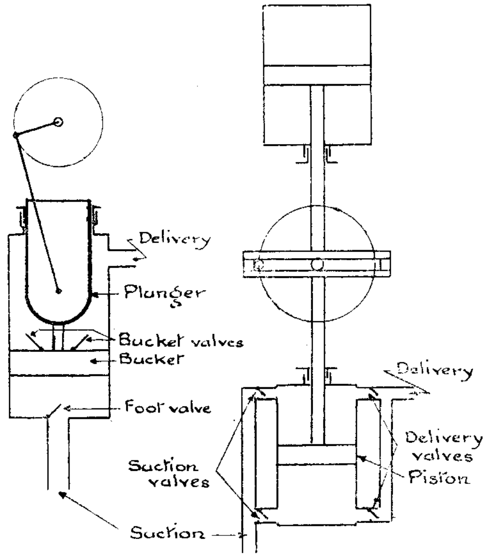
Mr. W. B. Hart comments upon Mr. Goodman's model

MR. GOODMAN, in describing his steam fire engine in the issue for February 6th, shows on page 187 that the pump is of the bucket and plunger type, but his description of the action of the machine does not tally with this.

In a bucket and plunger pump the plunger is made of such a size that its volume is half that of the pump chamber. The pump is double-acting, half the contents of the pump chamber being discharged on the down stroke by the plunger, and half the contents on the up stroke by the bucket, which also does all the suction work.

The action is as follows :—

By the up stroke of the bucket, a complete charge of water for the pump chamber is drawn through the foot valves. On the down stroke, this charge of water opens the bucket valves and passes to the top side of the bucket ; but owing to the presence of the plunger, there is only room in the pump chamber for half this charge of water and consequently the other half is forced out into the water-box. On the next up stroke the half charge of water remaining above the bucket is forced out into the water-box, and a fresh complete charge of water is drawn into the pump chamber below the bucket.



PUMPS

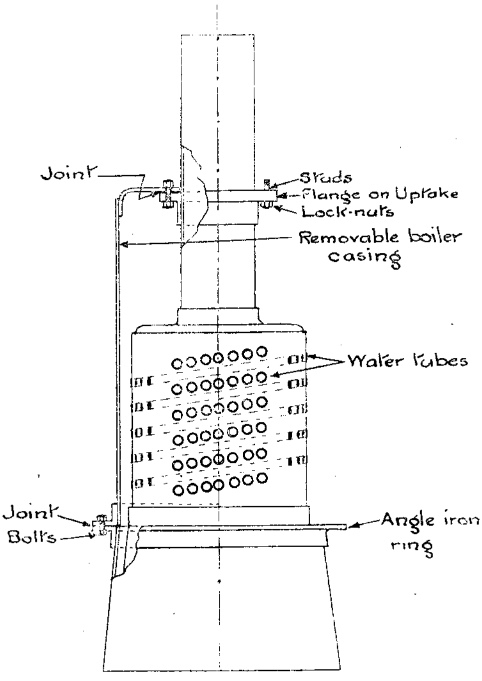
BUCKET & PLUNGER PISTON TYPE.

DIAGRAMS ONLY

Some of these fire engines were fitted with a piston-type of pump ; in these the piston was solid (i.e. there were no valves in it) and each end of the pump chamber had both a suction and a delivery valve or valves.

On the up stroke, the upper portion was discharged and the lower portion charged, and on the down stroke the upper portion was charged and the lower discharged. There was only a single piston-rod and pump-rod which were in line and connected together by means of a slotted crosshead, or Scotch crank, which drove the crankshaft for limiting the stroke and driving the slide-valve and feed-pump. See sketches above.

In the boilers of the prototypes, of which Mr. Goodman's model is a very close copy, the upper portion of the boiler barrel is removable so as to get at the cross water-tubes in the combustion-chamber. See sketch.



BOILER

CASING IN PLACE CASING REMOVED

The removable portion consists of the parallel barrel and the crown plate—it looks like an inverted jam-jar. At its lower end, it is finished with an angle-iron ring which is attached to a similar ring on the upper end of the conical firebox-casing by means of bolts (Mr. Goodman's drawing shows this angle-iron joint, but riveted, not bolted).

The upper end of the removable portion, that

(*Continued on page* 713)

THE SHIP MODEL SOCIETIES

By "Jason"

SHIP modellers throughout the country are getting into their stride again. I'll bet that quite a number are rushing up the final touches on their entry for this year's "Model Engineer" Exhibition. Strong provincial entries are expected from Sheffield, Birmingham, Leicester and Bristol. I expect no fireworks in the standard of modelling, but it will be interesting to examine the new modellers' work. 1946 was, as I expected, too soon for the main body. Nevertheless, there was much promise in many entries. Models like *L'Aigle*, *Morpeth Castle* and *Herzogin Cecilie* (McNarry) are clear indications of an excellent standard to come.

Birmingham

This society is well away to what I regard as a record in numbers. The chairman, Mr. A. E. Field, tells me he is pleased with the work "on the stocks." The first meeting was held at the Golden Cross Hotel, Aston Cross, Birmingham, and among those present were a number with much sea experience. There was also one marine artist. I am a strong believer in having artists among the members. Mark you, it's mutually beneficial. The artist has an ample supply of "models" to work on and he is among those who will criticise and elevate his "correctness of detail." Birmingham is also fortunate in having a draughtsman and publicity agent enrolled. Good luck, Birmingham! Write—Secretary, R. E. Walker, 72, Thetford Road, Great Barr, Birmingham 22A.

Wembley

Quite a few years ago a couple of strangers sat upon my very comfortable settee. We discussed the formation of the first London Ship Model Society, and I pointed out that usually the chairman got the praise and the secretary got the blame. Alec Purves took on the secretary's job, and a fine job he did. He is handing over to another for the first time in all these years, but fortunately Wembley (and indeed most ship-modellers) will still have his help and co-operation, for he remains as treasurer. He has done much good work in flags, a very often neglected subject, and was a frequent contributor to *Ships and Ship Models*. A sincere Thank You! Mr. Purves and good wishes to the new secretary, Roger Finch, 32, Bedford Road, Harrow, Middlesex. The club meets on the first Tuesday each month in St. Andrews Hall (side door), Ealing Road. Quite close to Wembley (L.M.S.) Station. July 1st—*Sketches, Photographs and Plans* by Members.

Streatham

South West Ship Modellers are meeting twice monthly, one of which is an informal meeting at a member's house. Mr. H. R. Glover, an ardent modeller from Australia, was elected an honorary member during his stay in this country. Final arrangements are now being made for a visit to the s.s. *Mitcham*, one of the Wandsworth & District Gas Co.'s ships. The s.s. *Mitcham* (popularly one of the "flat-irons") is one of London's very own ships, and thousands of people watch with some expectation hoping they will see her scratch a bridge on her way up and down the Thames. By the way, Secretary Tucker advises me that much of the National Maritime Museum will be closed for renovations and repairs for some months at least. South West London meets on the third Wednesday each month at Balham Labour Club, Balham Park Road (by Balham Station). Write—Secretary at 23, Farnley Road, South Norwood.

The Ropes on a Ship

The Streatham chairman, Mr. V. O. Lawson, who is an expert on Early Egyptian vessels, caught me aback on *which kind of ship had most ropes per mast*? He entered a plea for a one-master boat from the Tomb of Meket-Re (c. 2000 B.C.). The number is 137. Well! He said, "It may surprise you to know . . ." It certainly did.

Arterial Forceps

I am reminded by my colleague, Mr. V. O Lawson that *Down Bros.* are in amalgamation and the address is now *Messrs. Down Bros. & Meyer & Phelps Ltd*, 23, *Park Hill Rise, Croydon*, with showrooms in 22a, *Cavendish Square, London, W.*1. He also tells me that there is a smaller kind of forceps known as "Mosquito" forceps which could be used for very fine work, *but* they are fragile and expensive.

Sheffield

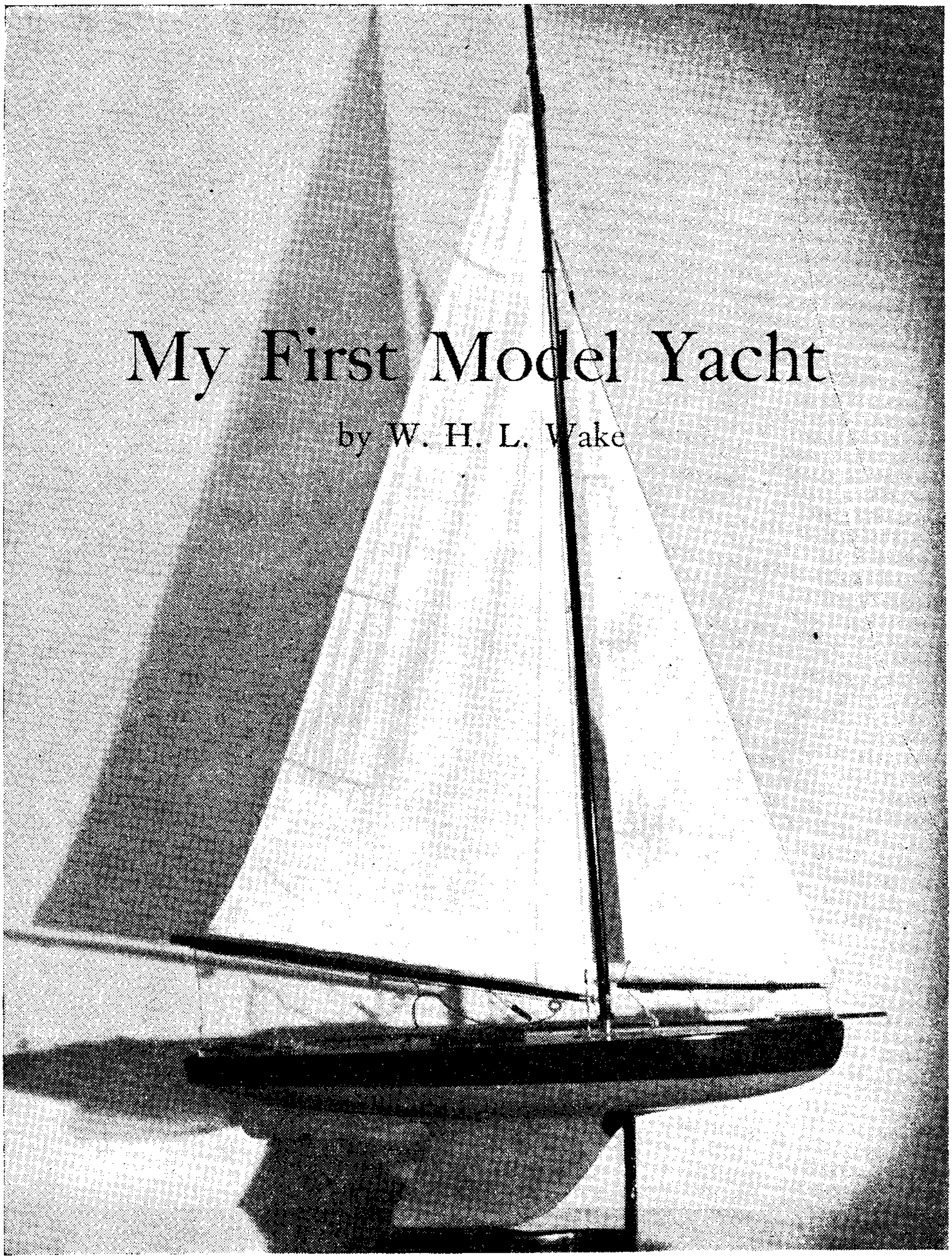
This society had a successful result from the Exhibition and many new members have come along. There are two "urges" at present, viz. preparing for the "Twentieth" in London. A number of the members are sending entries. The other "urge" is sketchbook and camera on the seaside holiday. Mr. Anthes (the chairman) tells me that in correspondence with the firm of R. D. Lambie, The Quay, Wallsend-on-Tyne, who are well known for their work in building ship's lifeboats, he discovered they are interested in having a working model made of a ship's boat at a scale of ¾ in. or 1 in. to the foot. If this should catch the eye of anyone who specialises in that kind of work and who lives near at hand they should communicate with the firm. The manager promises any such one "the run of the yard," which does not often come the way of a modeller.

The Sheffield Society meets on the first Thursday in the month in The Howard Hotel, Howard Street, Sheffield 1. Write—Secretary, Mr. Maltby, 32, Abbeydale Park Crescent, Totley Rise, Sheffield.

North London

Meets regularly on the first Friday in each month at The Club House, 19, Compton Terrace, quite close to Highbury Corner, Islington. The

(*Continued on page* 710)



My First Model Yacht

by W. H. L. Wake

I AM a carpenter by trade, and have worked on buildings all my life, but being a person who is interested in all the various things in life, I turn my hands to anything that interests me. When war was declared, I ceased working on the buildings and started work in "Vickers Armstrongs" Aircraft factory, at Weybridge, where I made the acquaintance of some very good pals, who later turned out to be interested in sailing of model boats (sail and steam). I will say here, that up to that date I had laughed at anyone I saw with model boats, and said to myself, just like kids playing with toys. However, my pals asked me if I would like to spend an afternoon with them at the pond and, rather than show any lack of interest in what I considered child's play, I accepted the invitation. I confess that previously I had never seen a model boat at close quarters,

and was so amazed at the beautiful specimens of work I was viewing, I at once asked what the price of these boats was, and where they were bought? Well, you will understand the amazement of the craftsman, Mr. Pullen (who afterwards turned out to be our skipper) who said, "What! we *don't buy* our boats, we *make them*." I was dumbfounded, but said nothing. My pals were busy assembling their craft, so I stood around watching and wondering. The boats took to the water, and from that moment on, I knew I was going to make a model boat myself. The afternoon I spent watching *others* sailing *their* boats was one of the most enjoyable and instructive afternoons I had spent.

Later, it was suggested by one of my pals (Mr. Pledger) that we form a model club. The club was formed, and named, "Vicker's Armstrongs" Model Club, to which I wish all success, and to all other clubs, and model makers.

The club being formed, we set about our plans, but alas, where was I to get the timber from to start with. I couldn't buy any from work, it was needed for more important things at that time. I hunted here, there and everywhere, but could not get hold of the timber I required. Then I had a brain-wave. Ah! I said to myself, what about the shelves in our cupboards. They turned out to be the very thing; three lovely deal boards with very few knots, that was all I wanted; out they came and into the shed. I started marking out, happy as a sand boy; until—the following evening my wife wanted to know where the shelves had gone from the cupboard, I confessed, had an argument, then settled down undaunted to making my *first* model. (My wife has since forgiven me, after seeing what can be done with odds and ends). I have a tremendous amount of patience, so I got down to some steady happy evenings and week-ends.

The hull was completed and I could not help admiring it every time I went into my shed. Then came the fittings. They could not be bought so I had to go round finding any pieces of old brass. Then followed the shaping and polishing until the home-made fittings were far superior to any shop bought ones, which I've since seen. Not only are they a saving, but it is a great source of pleasure, to make your own. At last they were finished and fitted to the deck. The sails were made from a length of mercerised poplin which I was keeping to make a shirt with, but as I had a more important job to do with it, the boat won. The mast, jib and boom were shaped from some strips of spruce which a firm near my home was selling for firewood.

At last the model was ready for decorating. Off came the deck fittings and these were carefully put away until the final fitting together again. The colours I had decided on were blue and grey. The smoothest, and smartest finish I knew of was cellulose. But I didn't know how to put it on evenly. After various attempts with a brush, all of which, to me, were unsatisfactory, I tried an ordinary "flit" sprayer, and after thinning my cellulose down to water consistency, I managed at last to get the finish I wanted. First I sprayed the hull all grey until I had a good body, then covered *from* the waterline down, all the grey which I didn't want to spray blue. After putting 12 thin coats of grey and allowing to dry, I removed the cellulose tape and re-covered the grey I'd just sprayed, taking care to see my waterline was perfectly true, then applied 12 thin coats of blue. Twelve coats of *each* colour gave me the same thickness at the waterline and enabled me, with very little trouble, to get the perfect finish which is on my model.

I would like to state here that my model first went into an exhibition at Staines, at very short notice, while it was in a rather dirty condition. the workmanship was "Highly Commended." She was next exhibited at Vickers Armstrongs sports field where we had arranged a models exhibition, open to all. The result was a First Prize Win in open competition and the Vickers "Challenge Cup." She was then exhibited at the "Model Engineer" Exhibition in London, where she won in her class the Bronze Medal. The bronze medal was for my model, the thrills and the pleasure were for myself, for to all persons achieving an ambition *there is no greater prize* than to see others inspired by, and admiring your achievement.

The tools used were very ordinary carpentry tools, wheel brace, twist drills, metal polish, flit sprayer and a Singer sewing machine.

The Ship Model Societies

(*Continued from page* 708)

May meeting was addressed by "Jason" on *Markets and materials for modellers*. The Junk Shop and the Saturday Market Street are good places to pick up yellow pine in backs of pictures, backs and sides of dilapidated drawers. There are ebony and boxwood rulers in the cheap stores. The bread board, the meat board, the broken fishing rod and the billiard cue are the very woods that modellers look for—and they are well seasoned. Old venetian blinds? There's nothing better. Card-index boxes? Just look at the sides, bottom and back. Write to Angler Supply firms for particulars of the finest of silks for rigging miniatures. Surgical silks are also very fine. North London are making special efforts for this year's "Model Engineer" Exhibition. Write—Secretary, M. E. Moon, 53, Freegrove Road, N.7, for syllabus.

Ilford

Mr. Chapman tells me that the meetings are still informal but visitors are always welcome. The society has some really excellent modellers, so if you live in the locality write—Secretary, R. A. Chapman, 218, Old Ford Road, London, E.C., for particulars.

*A Tandem Compound Engine

By "Crank Head"

A SIDE elevation of the bridle-gear which actuates the piston valve, is shown in Fig. 53, and studied in conjunction with previous remarks, does not need much further description, a few remarks concerning the valve spindle may, not be amiss, however. It will be noted that the lower portion of the spindle is screwed, this does *not* screw into the crosshead at X, the hole through X being a clearing-hole, which permits the crosshead to travel between the adjusting nuts on the spindle without moving the valve. The valve is only moved when the crosshead meets the nut at either end of the stroke.

Before considering this any further, it will be necessary to refer to Fig. 52, which gives two views of the cylinder, and one of the valve-face. The valve, it will be seen, has five ports, two steam, and three for exhaust. In A, Fig. 52, the top and bottom ports are those through which live steam passes, and, having forced the piston to the end of its stroke, the steam is passed through either one of the intermediate ports and so into the exhaust port which is the centre one. The pump with the valve in the position shown at B, Fig. 52, would not start, because, of course, both steam ports are closed, and the two inner ports are open to exhaust. This valve is designed to take steam from the top, and, as the valve is hollow, there is always live steam in the valve-chest, both above and below the valve, whilst the centre portion of the valve is always open to exhaust.

The travel of the valve is such that, when the steam port is open, the what can be called exhaust steam passage is closed. To make this a bit clearer, imagine the piston at the top of its stroke, the valve will then have moved to a position in which the top steam port, 1, is wide open, whilst the exhaust passage, 2, is closed. The piston now moves to the bottom of the stroke, carrying the levers of the bridle-gear with it, the crosshead X, Fig. 53, moving towards the adjusting nuts on the upper end of the valve-spindle, pushing the valve upwards until the other steam port, 4, Fig. 52B, is open to steam, and the exhaust passage, 3, is closed. This movement of the valve admits steam to the underside of the piston, which, of course, is forced again to the top of the cylinder, the bridle-gear in the meantime having pulled the valve spindle, and valve down, thus opening the top port to steam. A flat-valve could have been used instead of a piston-valve ; but it was thought, rightly or otherwise, that a piston-valve would eliminate a certain amount of friction which would be caused by the steam pressure on the back of a flat valve—perhaps it was only a fad of the writer's.

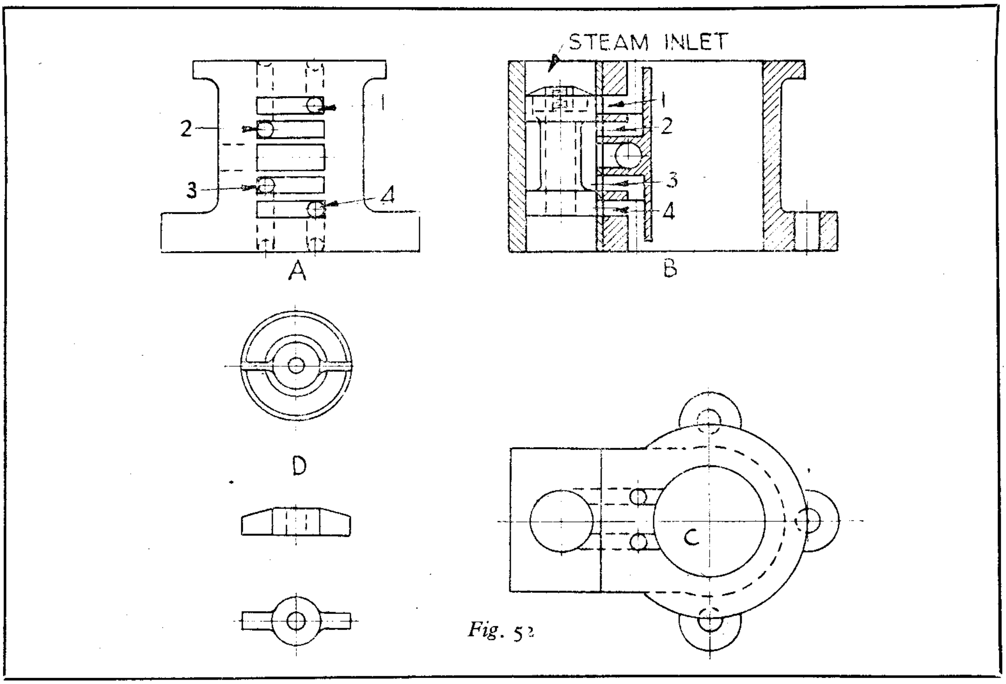


Fig. 53

**Concluded from page* 698, *"M.E." June* 5, 1947.

A few remarks *re* construction of the piston-valve, which is ½ in. in diameter, may be of interest. The valve was first rough-turned externally and the bore was turned to finished dimensions, as shown at B, Fig. 52. The bridge was then made as at D, Fig. 52, the centre hole for the valve-spindle not being drilled. A slot was then cut across the top of the valve, and into it the flat portions of the bridge were neatly fitted, care being taken that the boss was in the centre of the valve; the bridge was then silver-soldered in place.

The valve-chest is like nothing on earth; for the ports are not cut right around it, and liners fitted as would be done in the ordinary course of events. As can be seen at C, Fig. 52, the valve-chest is a rectangular piece of cast-iron (more from the railings) with a hole bored through it to take the valve, and the ports, which are a series of round holes drilled in one face to meet the bore, and, of course, spaced so that they are dead in line with the ports in the valve face.

A metal jig was made for cutting the ports, and was used both on valve-face, and valve-chest. The valve-face on the cylinder and the port-face of the valve-chest were now scraped up to a surface-plate, and when satisfactory, the two mating faces were lapped together with a fine lapping compound; this was essential, as any leakage of steam from one port to the other would upset the whole show. A reamer was then passed through the bore of the valve-chest to make sure that there was no distortion in the bore, and then the valve was turned to a size such that it would have been a driving-fit in the bore of the valve-chest.

Two laps were now made, a solid one for the bore, and a hollow one for the valve. The hollow lap was a facsimile of the valve-chest, except that there were no ports in it, and that it was split with a fine saw down one side, parallel with the axis of the bore. Two screws were then fitted in such a position that by screwing them up the lap could be closed by a very small amount. The bore of the valve-chest was then lapped out, and the valve lapped in the hollow lap; this was continued until the valve could just be pushed through the bore. The valve and the chest were then lapped together until the valve was a fit. This operation took several hours to complete, but the result was well worth the trouble.

The two faces, i.e., on the cylinder and valve-chest, were then ground together again using the very fine lapping compound. The six holes for the securing studs were then drilled in the valve-chest and the cylinder valve-face, studs made and fitted, the two faces smeared over with a thin mixture of red-lead and gold-size, and then jointed up. The whole job, on test, was a complete success. It may be stated here that the piston-valve is of mild-steel.

The round columns, three in number, which connect the steam and water ends of the pump are just ordinary turning jobs, the chief point being to make sure they are all of one length between the faces of the collars.

The assembly of the pump was the next consideration; and here, the writer had some misgivings, for, unless the alignment of the cylinders was absolutely above suspicion, there was certain to be trouble. The holes in the brackets on the steam cylinder had previously been drilled. To ensure alignment, a mandrel as at Fig. 54, was turned from a piece of mild-steel, the diameter of A being a fit in the steam cylinder, and B in the liner of the pump. The centre-lines on each cylinder having previously been marked, it only remained to place the mandrel in position in the cylinders, bring the centre-lines of both to register, and mark the holes from the steam cylinder on the lugs of the water-end; a circular scriber for the purpose was used. The mandrel was withdrawn, holes carefully drilled and tapped in water-end, the columns were fixed in position, the pistons and rods assembled in their respective cylinders, and with the covers on both cylinders the alignment was tested; this proved correct, and the remainder of the pump was completed. On testing with compressed air, at 100 lb. per sq. in., but not pumping water, the pump worked so quickly that it could hardly be seen to be moving. What will be the result when driven by steam, and pumping water against boiler pressure?

The next auxiliary to be made was the hand pump, which takes its suction from the hotwell tank, and is intended as a stand-by in case of failure of the main feed pump. No attempt will be made to describe this pump, save to say, that it is similar to one designed by our old friend, "L.B.S.C.," for his "Austere Ada." The writer tenders his sincere thanks for the design, and for the opportunity of using it. The only difference between the original and the copy is that the latter is much larger. The pump and actuating gear are mounted underneath the engine and cannot be seen in the photographs.

All the lubricators on important bearings in the engine are fitted with siphons and wicks; they were all built-up. The two most difficult ones were those fitted to the main bearings, and illustrated at Fig. 55A. Fig. 55B, shows the method of making the siphon, the outlet end of which had to be at an angle of 45 degrees, with the body of the lubricator. A piece of brass of suitable size was drilled as shown dotted at B, screwed, fitted with a nut which is silver-soldered in position, and then bent to the required shape. Two attempts at bending ended in disaster, due to making the bend after screwing; success was finally achieved by cutting the thread after bending. The bent portion was next inserted in the body of the lubricator, in which it was a good fit; the screwing operation being carried far enough up the stem, so that when the nut was screwed right to the end of the threaded portion and the lubricator screwed into the main bearing, the whole thing stood upright. The silver-soldering operation was then carried out, and finally a drill was put down through what was to become the siphon leaving it as at A, Fig. 55. The covers are a push-fit in the body of the lubricator.

The keyways in fly-wheel, and eccentric-sheaves, were cut on a home-made slotting-machine; the interior of the L.P. valve-chest was also machined in the same way.

The tiled flooring around the engine has been

the subject of comment by many who have seen the model; the tiles are made of white celluloid, 3 mm. thick, and the insets and boundary are of ebony.

The construction of the engine and auxiliaries has involved the making of about 157 studs, all of which, with the exception of the shortest 3/32 in. studs, which could not be held, are screwed the correct amount from each end, with

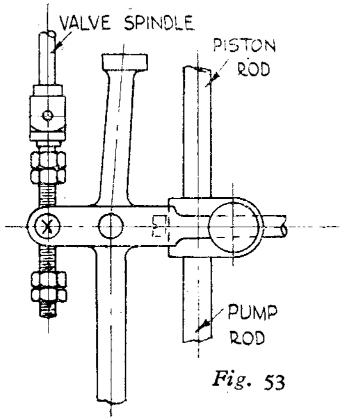


Fig. 53

a plain part left in the middle of each. Fifty bolts of various sizes, and fifty nuts of the latter, the greatest number are $\frac{1}{8}$-in. Whit.; no desire is felt to have to repeat these operations.

There is still an engine to be made for driving the circulating-pump; this will be a vertical engine, $\frac{7}{8}$-in. bore × $\frac{3}{4}$-in. stroke. It is hoped to take this job in hand during the summer; at the same time, it is intended to make and fit spring-loaded relief-valves to each end of both H.P. and L.P. cylinders. Two pressure-gauges and one vacuum-gauge about $\frac{3}{4}$ in. to 1 in. diameter are required; these fittings to date have been unobtainable and any information as to where these could be obtained would be gratefully received.

It has previously been mentioned that all patterns for castings are home-made, and should any reader be desirous of making a similar engine, I would be pleased to loan them, at no cost, other than that of carriage.

Great pleasure has been derived from the labour involved, more pleasure, in fact, than writing about it, but, if the reading of this description gives readers some small fraction of the pleasure I have had in making the engine, or better still, if it arouses a desire in anyone to make one like it, well, I shall be amply repaid. It is feared the sketches may not be as good as they might, in extenuation, it may be stated, the writer is, or rather was, a boiler-maker, and the last lesson he had in machine drawing was in 1900, when he was an apprentice, and after the lapse of so many years, eyes and fingers are not quite as keen or nimble as they used to be.

In conclusion, I would like to offer my thanks to the friends who have come along "with this old bit of iron, or brass, which might be useful to you," and which have been useful, without

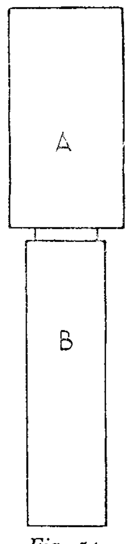


Fig. 54

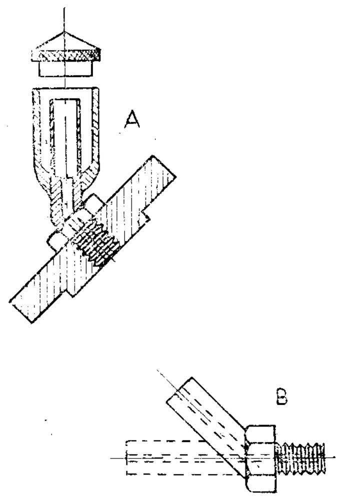


Fig. 55

any doubt; also to Mr. Wolf, of Newquay, Cornwall, who kindly came along and took the really beautiful photographs with which this article has been illustrated. Should there be any queries, a letter addressed to me through the Editor will be replied to by "Crank Head."

Fire Pumps and Boilers

(*Continued from page* 707)

is the crown-plate, sits on a flange riveted to the uptake tube; this flange is studded and the plate held down by nuts. All four joints are machined and the joints made with red-lead.

The removal of the boiler top enables the whole of the interior of the boiler and the water-tubes to be got at for inspection, de-scaling and repair, and owing to the fierce way in which these boilers are worked, this access is very necessary.

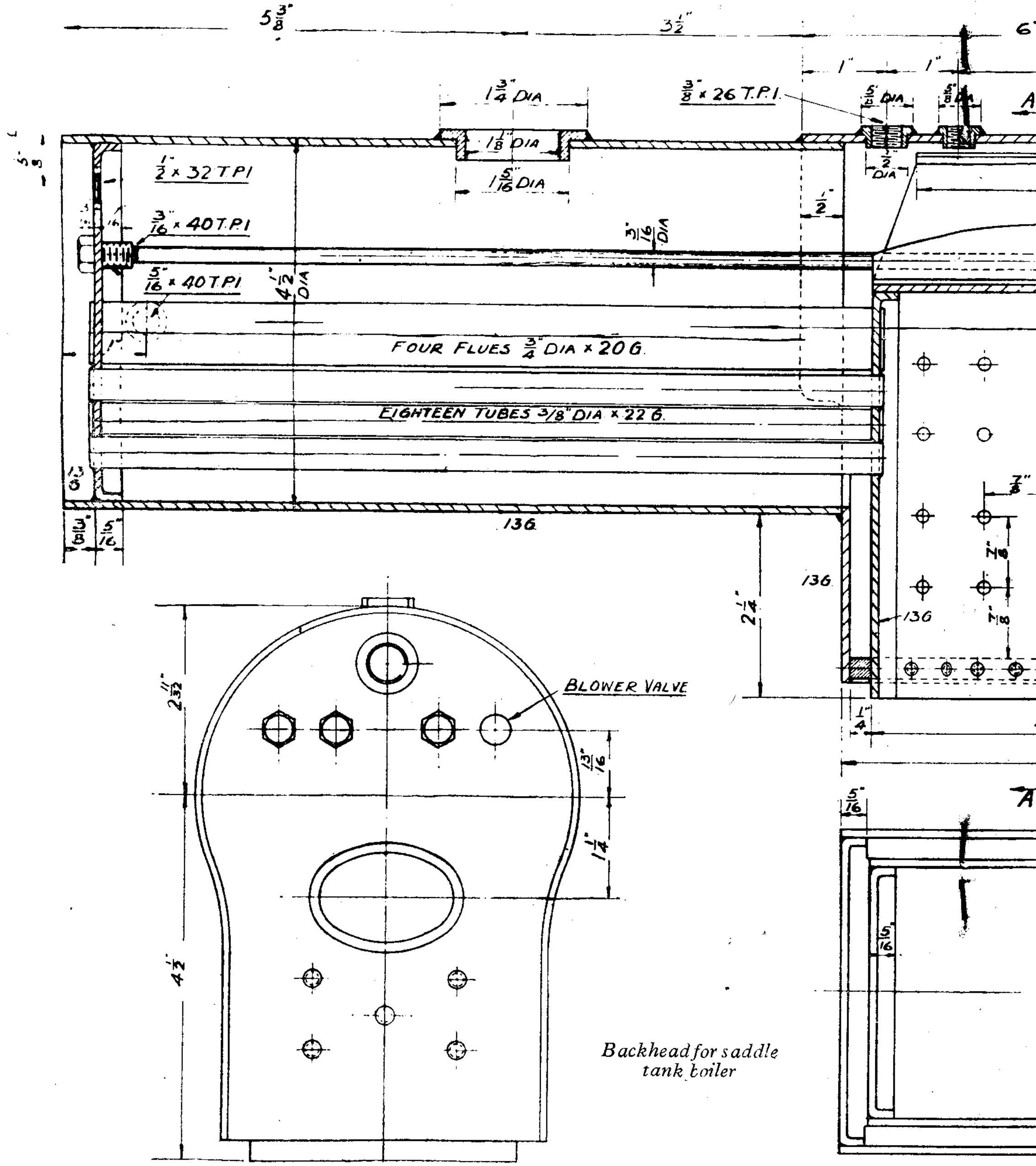
The smallest sizes of these boilers contain about 72 tubes; they are in layers, each layer inclined slightly upwards and at right-angles to the next layer—say, six rows of seven tubes running north and south alternated by five rows of six tubes running east and west.

Obviously, none of these tubes lies normal to the plate into which it is expanded, hence the need for access.

These boilers hold very little water and, when working hard, the feed wants *constant* attention if trouble is to be avoided; the water-spaces are extremely cramped, particularly in the coned portion of the firebox, where it is barely half-an-inch wide and some eighteen inches deep, and the upper part of this is further obstructed by the rivet heads of the angle-iron ring, making the use of tools for de-scaling impossible so that a solvent is desirable.

"L.B.S.C."—BOILER FOR MR

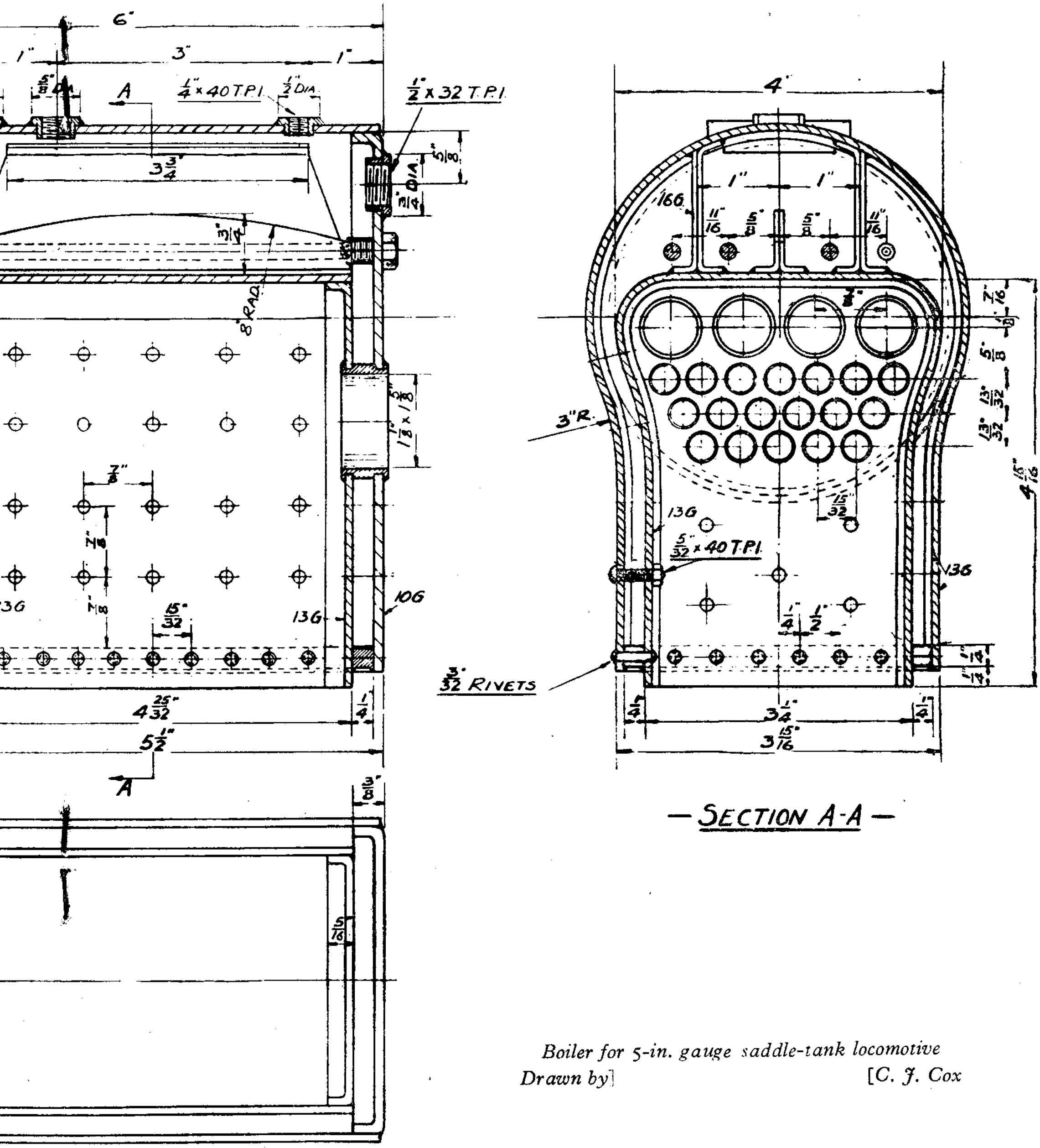
READERS who have launched out for themselves and are building "Juliet" to 5-in. gauge, or working to the outline and dimensions given for Mr. C. J. Cox's 0-4-0 saddle tank "Tailwagger," may be interested in the reproduced drawing of the boiler for the latter engine. As you can see, it follows the general practice of other boilers specified for real "Live Steamers" in these notes, having the same diameter barrel as the "Lassie"—though of "pug" instead of "dachshund" length!—with the same arrangement of tubes



Backhead for saddle tank boiler

MR. COX'S "TAILWAGGER"

and staying. There is no need to go into full details of construction, as the actual job is carried out in the same way as described for "Lassie," "Juliet" and other engines, and the drawing is self-explanatory. Mr. Cox has arranged the proportions of firebox and tubes, to the capacity of the boiler, very nicely indeed, and the boiler should prove a very fast and economical steamer; as the enginemen would say, "boss of the cylinders." The steam-producing capacity of these little short-barrelled kettles has astounded—and confounded!—all



Boiler for 5-in. gauge saddle-tank locomotive

Drawn by] [*C. J. Cox*

those who thought that the cure-all for bad steaming was "put the biggest possible boiler on the chassis." When I described the boiler for "Rainhill," it was laughed at openly in many quarters; but when a few of them began to perform on club tracks, well, you know the old saying about "those who laugh last, laugh longest." Old Curly still enjoys a quiet chuckle.

Finishing Off "Juliet's" Boiler

Reverting to the loco.-type boiler for "Juliet," we got as far as the final assembly, so the next job is to braze or silver-solder the foundation ring and backhead. As it is only quite recently that I described how to do this job on the "Lassie," there is hardly any necessity to go into full detail again. Compared with the "Lassie's" boiler, the job is dead easy; whereas the big boiler required enough heat to roast the proverbial donkey, a 5-pint blowlamp should be able to do the small boiler almost without any coke packing. Beginners and inexperienced coppersmiths would do well to use a coarse-grade silver-solder for this job, instead of the usual easy-running brazing strip; this will give them more latitude in keeping up the working temperature, and be good practice for their next boiler. Johnson-Matthey's B-6 alloy, with Tenacity No. 1 flux, is ideal for the job, and doesn't "break the bank" either. If these are not obtainable, however, the grade of silver-solder known as No. 3 in the trade (I believe the composition is about two of brass to one of silver) will do very well, using either Boron compo or jewellers' borax, mixed to a paste with water, for flux.

To summarise briefly, for beginners who have not back numbers handy; lay the boiler on its back in the coke, flux the joints, and put some asbestos cubes, pieces of mill-board, or anything fireproof (broken bits of firebricks, or gas-fire elements, for example) in the firebox to protect the tubes. Heat up the lot till nearly red, then concentrate on one corner of the foundation-ring. When bright red, apply the silver-solder, which should be in thin strip form about $\frac{3}{16}$ in. wide. Work your way slowly, right around; then up-end the boiler, and ditto repeato the performance around the joint between backhead and wrapper, finally doing the firehole ring and the boiler bushes. Let cool to black, and be mighty careful how you lower it into the pickle bath, or the solution will blow out all over your clothes or overall, and do more in the way of making holes than a whole colony of moths. In these days of coupons, this is a serious consideration. Well wash in running water after about 20 min. in the pickle; clean up, and test for pin-holes, as described for the "Lassie," by plugging the holes, pumping in some air, and baptising the whole doings in a tub of water. Bubbles will indicate any leakage; should any show up, just plug them with screwed bits of copper wire.

Staying

There are two longitudinal stays, one solid ($\frac{3}{16}$-in. rod) and one hollow ($\frac{3}{16}$-in. tube of 16- or 18-gauge) the former being fixed with two blind nipples, as shown on Mr. Cox's drawing. The hollow stay has a thoroughfare nipple at the smokebox end and the blower-valve at the firebox end, exactly the same as illustrated just recently for the "Lassie"; see issue for January 2nd last, page 15. My notes in that number give full details of making and fitting the blind and thoroughfare nipples, the blower-valve body, and the firebox stays; also directions for sweating up the stayheads and nuts. The procedure for "Juliet" is exactly the same, but as the backhead on "Juliet" is vertical, no wedge washers are needed between the nipple and blower valve on the backhead. Just screw them straight in, and make certain the blower nipple is up straight when the fitting is screwed right home.

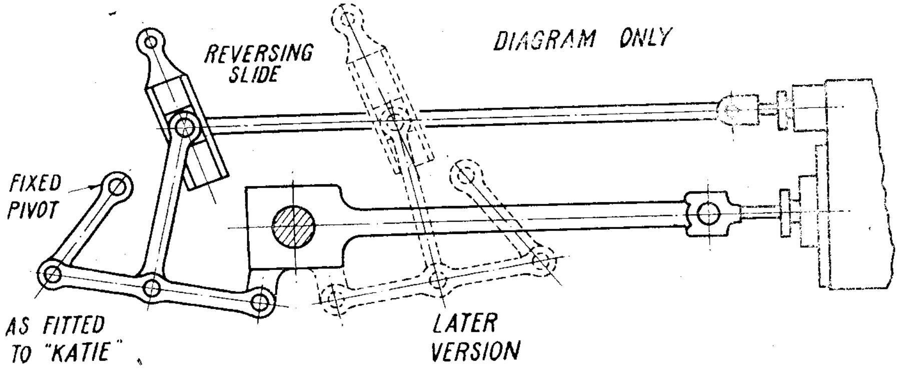
There are fifteen 5-B.A. copper stays, spaced at $\frac{3}{4}$ in. centres, in each side of the firebox; two in the throatplate, and two in the backhead. They are put in as described in the number mentioned above, drilling the holes with No. 40 drill, and tapping 5-B.A. The staybolts themselves are made from $\frac{1}{8}$-in. soft copper wire cut and screwed as for the "Lassie"; but as 5-B.A. brass locknuts are a commercial "line" (Reeves, of Birmingham, specialises in this sort of thing) there is no need to make them. When you have put all the stays in, sweat over the heads and nuts, as described on page 17 of the issue referred to, and the boiler will be ready for hydraulic pressure test. For this, you will need the emergency hand pump, which goes in one of the side tanks, and all being well, I will describe this in the next instalment of "Juliet serial."

The "Grasshopper" Valve-Gear

As several readers have requested information as to the origin and working of the "grasshopper" valve-gear, maybe a few words here, will save a lot of unnecessary direct correspondence. The gear in question is a variation of Joy and Hackworth, and collected its nickname by virtue of reminding one, when in action, of that interesting insect hopping over the grass. It has a radius-rod and die blocks, like Joy's, working in guides, but the latter are straight, as in Hackworth's gear; the die blocks are moved up and down the guides by a connection with a swinging link actuated by the big end of the connecting-rod. The tail of the swinging link is suspended from a connection anchored to the frame, and it is the grasshopper-like action of the swinging link, that gave the gear its name.

To the best of my knowledge and belief, this particular form of valve gear was originally designed by Sir Arthur Heywood for the locomotives of the Duffield Bank Railway, a small private 15-in. gauge line in Derbyshire; this was way back in the 'nineties. In 1894, a similar line was decided on for the Duke of Westminster's estate at Eaton Hall, near Chester, and the estate agent, a Mr. C. Parker, saw the Duffield line in operation, and gave the order for the building of a suitable 15-in. gauge locomotive to the same maker, Mr. Percival Heywood, who had supplied the Duffield engines. I have before me at the present moment, a copy of the "Railway World," for December, 1896 (note the date) which gives particulars of the then new Eaton Hall railway, and details of the locomotive, with photographs.

She was an 0-4-0 side tank engine named "Katie," with cylinders 4⅝ in. by 7 in., driving wheels 1 ft. 3 in. diameter, a boiler with a peculiar firebox, a total heating surface of 53 sq. ft., and carried 160 lb. working pressure. The total weight was approximately 3¼ tons. This engine had outside cylinders, with valves on top actuated by the original grasshopper guides curved to the radius of the long rods, they would have been very nearly straight; so the fitting of perfectly straight guides made little difference to the correctness of the valve events. Anyway, "Katie" did her duty nobly for many years on the Eaton Hall line, until superseded by an 0-6-0 named "Shelagh," which was much more powerful. She, in turn,



The Heywood grasshopper valve-gear

valve-gear, plainly discernible in the photographs.

Now it is a well-known fact that the original Joy valve-gear had the anchor links pointing away from the cylinders, in cases where it was more convenient to place the supporting brackets on the frame; see page 72 of Ahron's "Development of British Locomotive Design" for an example. You'll probably find this book, also bound volumes of the "Railway World" referred to above, in the Reference Department of your local library. It made little or no difference to the operation of the gear, or the valve events, whether the anchor links pointed fore "or aft" as our nautical friends would remark, for the simple reason that Joy gear has curved guides. the radius of which is the same as the length of the radius-rods between centres. Not so in the case of the Heywood gear. The straight slides made it imperative that the radius-rods should be as long as possible, in order to get a good steam distribution; and for this reason, the swinging links on "Katie" were attached to the rear of the big ends, and connected to hangers under the bunker. This enabled the straight slides to be placed right back under the footplate and very long radius rods connected the die-blocks to the valve-spindles on top of the cylinders.

Anybody who has any practical knowledge of radial valve-gears, won't need reminding that the best distribution of steam in the cylinders, is obtained when the end of the radius-rod moves in a slotted link or guide, curved to its own radius between centres, as in the case of Joy and Walschaerts gear. Therefore, it stands to reason that when straight guides or links are used, the radius-rod should be the longest possible that can be fitted; it is obvious that the errors introduced by using straight guides instead of curved, are much less when they are taking the place of curved guides with a long radius, than if same were of shorter radius. In the case of "Katie," had she been furnished with

was displaced by an internal-combustion locomotive (loud groans and cries of "shame!").

Some "Improvement"

No matter what invention, design, or device is put into use in this benighted world, even if it gives reasonable satisfaction, there is always somebody ready and anxious to "improve" it. I well recollect the case of the Griffith-Bedell surface-contact electric tramway system, evolved in the early days of London tramway electrification. When the question of electric traction for the Aldgate-Bow Bridge section came up, the L.C.C. were in a bit of a quandary. They favoured the conduit system, but owing to the top of the District Railway tunnel being so close to the roadway on part of the route, there was no room for the conduit. The local Borough Council objected to overhead trolley wires, so matters were at a deadlock until the adoption of the G.B. surface-contact system was advocated. In this system, metal studs are laid between the rails, and connected by magnetic switches to a cable laid in a stoneware pipe just below the surface; and in the original design, the studs are only "alive" when the collecting shoe on the tramway car is actually touching them. Well, somebody on the Council, who belonged to "Pat's Improvement Class," wasn't satisfied with the magnetic switches as originally designed, and substituted or introduced his own ideas, with the result that on the opening day, nearly a thousand of the studs failed to "switch off" after the passing of a car, and horses and pedestrians were receiving free electrical treatment, stepping on the studs and falling down like skittles! Needless to say, the whole bag of tricks was promptly "canned," the track being relaid partly on the conduit system, with overhead trolley wires where the tramway lines were directly over the District tunnels; a fine expense to the unfortunate ratepayers!

Well, returning to the grasshopper valve-gear, this also came under the notice of "Pat's Improvement Class;" a member of same thought the gear was spread out too much, and would be better if "condensed" a little, with the slides between the crank axle and the cylinders, as in Joy gear. He promptly turned the swinging link around the other way, and put the hanger supporting it, on the frame near the end of the guide bars. The slides were placed almost immediately above the centre of the swinging link, necessitating a short radius-rod. To obtain correct distribution, as with a proper Joy gear, the slides should have been curved to the radius of these short rods between centres; but the straight slides were retained "for the sake of simplicity"—with apologies to a well-known catalogue—and it doesn't need a Sherlock Holmes to deduce the errors introduced into the valve events by the difference between the hypothetical sharp curve and the actual straight slide! The gear looked fine on paper, and was applied to a number of commercially- and professionally-made locomotives (among them the 3¼-in. gauge "George the Fifth," mentioned in my reminiscence about "the Colonel" and his "Claughton"), but I never heard of any one of them that ever put up a performance "worth writing home about," as they say in the classics. To make matters worse, on most of the engines fitted with the gear, there was no provision for lap, lead, or early cut-off, the radius-rods being connected direct to the die-pin, so that both admission and cut-off were far too late. In the days when I could find the time to do a bit of rebuilding and repairing for friends and correspondents, a good many engines fitted with this gear passed through my hands, and it was invariably the cause of the locomotive refusing to do the job. Even with a specimen of the gear put up with correctly-fitted pin joints, the distribution was "all over the shop," in a manner of speaking. In several cases I did my utmost to make it put up some sort of a show; but even the fitting of a new vibrating lever, which connected the swinging link to the die-blocks, and making provision for lap-and-lead movement *à la* genuine Joy, would not enable an engine to be notched up and keep even beats. Syncopation began as soon as the lever was moved off full gear positions. I rather think the member of "P.I.C." was aware of this, because a lever with three positions only, viz., full forward, full back, and middle, was always specified.

The original Heywood version of the grasshopper gear was fitted to a few big engines used in industrial plants, and also to the early Snowdon Mountain Railway engines, being modified to suit the peculiar system of connection between cylinders and cranks used on these engines to obtain increased leverage. However, like many other valve-gears, it has now "died a natural death"; and as it is just as easy to make a proper copy of Stephenson, Joy, Walschaerts, Baker or any "established" gear, which will give correct and economical steam distribution, and can be notched up to very early cut-off, there is not the least atom of excuse for resurrecting it.

A Hefty "First Attempt"

The reproduced photograph shows a 3½-in. gauge South African type of locomotive, built by Mr. W. Celliers, of Ladybrand, in the old Orange Free State. She is not a copy of any particular type, but a combination of several, the information being gained from observation of actual full-size locomotives, study of photographs, and gleanings from these notes. I have no details of her dimensions, but she can pull and go; the only available line is a half circle, 75 ft. long, and the only available rolling-stock is an unsprung plain-bearing eight-wheeled car, on which two adults and a kiddy can be squeezed with a spot of "rush-hour packing." With this load she starts off easily and accelerates rapidly, and there is no trouble in maintaining steam. Our worthy friend makes apology for his workmanship; but judging from the picture, he has nothing to complain about.

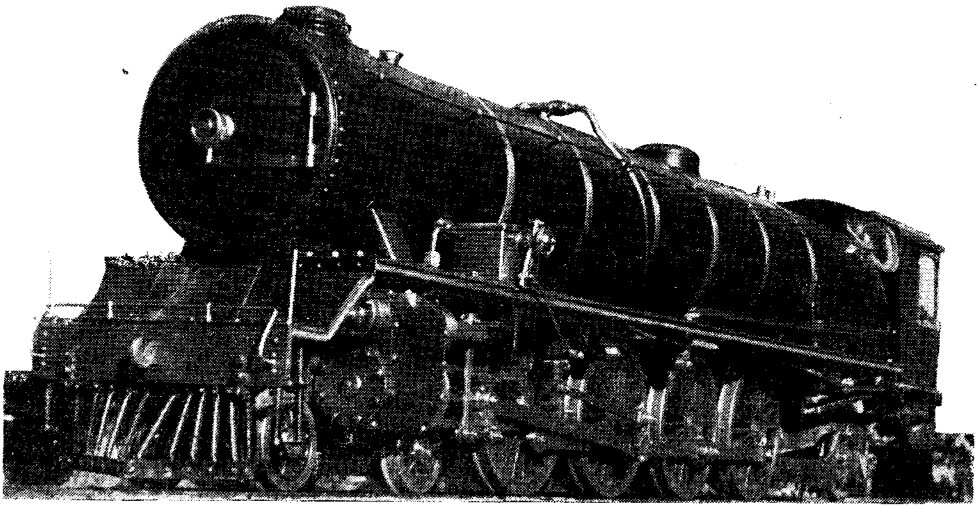


Photo by] *A South African weight-shifter built by Mr. W. Celliers* [*C. Van Wyk*

PETROL ENGINE TOPICS
* A 15-c.c. FOUR-CYLINDER ENGINE
By Edgar T. Westbury

BEFORE leaving the timing gear, one or two comments on the details which have been described may be advisable, to anticipate possible queries. It will be seen that the flange of the idler stud overhangs the bore of the main bearing and that the screws securing this stud have to be kept fairly close to the bearing. If the screws were the only means of securing the stud, this might well be considered an inadequate form of mounting, but in fact it is only necessary for the screws to hold the stud in place while timing gears, before the timing cover is assembled, after which the nut on the stud will provide further security.

The flange seating might be improved by leaving an internal lip on the outer end of the bore of the bearing housing, but it is important that this should not bear against the end of the ball race, which should be free to take its own end location at the timing end.

It may be found necessary to mill or otherwise remove a little material from the inside of the timing cover, to clear the lower foot of the idler stud flange. There is plenty of material in the casting at this point to allow of doing this without impairing the joint surface to any undesirable extent.

The hole in the timing cover for the end of the camshaft will have to be made larger than shown in the detail of this component, for the recommended method of fitting the ignition distributor, but as one or two optional arrangements will be described, this matter will be referred to later.

The timing pinion on the crankshaft is held in place by the nut on the end of the shaft, acting through a sleeve which is a running fit in the bore of the timing cover, and acts as an oil retainer. Details of this sleeve have not yet been given, but will be shown later, and in the event of the engine being coupled to the drive at the timing end, the coupling, sleeve and shaft nut may be made all in one piece ; alternatively, a starting dog or similar device may be substituted for the coupling.

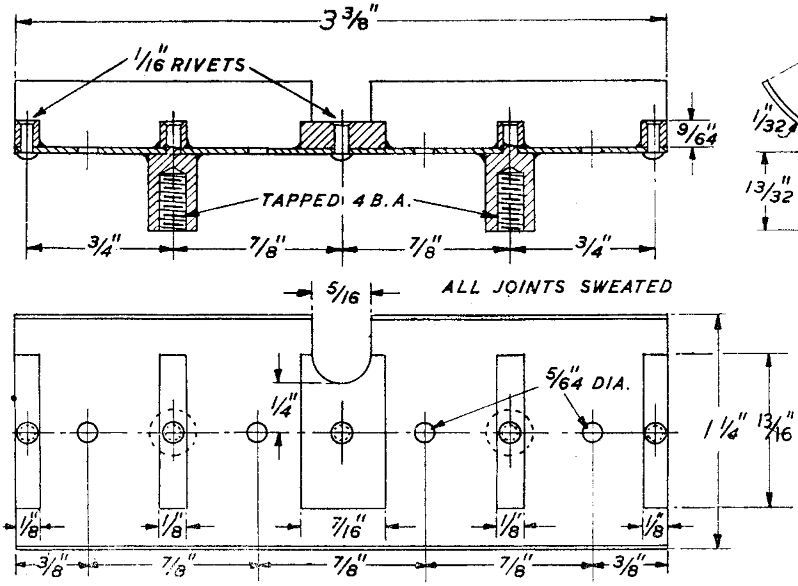


Fig 31. *Oil trough*

Oil Trough

The methods adopted for lubricating small petrol engines have, in general, been rather primitive, and although they have served their purpose more or less satisfactorily for runs of short duration, there is much room for improvement by the adoption of more positive, automatic and reliable means of supplying oil, especially when the engine is intended for long continuous running without attention. Unlike the two-stroke engine, in which oil can be taken in with the fuel, the four-stroke type of engine calls for separate oiling arrangements, though there are many practical advantages in keeping the lubrication apart from the fuel feed in any engine. As the mixture does not pass through the crankcase of a normal four-stroke engine, it is possible to keep fairly large quantities of oil in circulation, and to use the oil as a coolant as well as a lubricant.

I have described several methods of lubricating engines in the past, including automatic forced

* *Continued from page* 666, " *M.E.*," *May* 29, 1947.

lubrication by means of engine-driven pumps of various types. It is quite practicable to fit a pump on this engine, though the restricted space makes this rather difficult, and a positive supply of oil to all the big-end bearings entails drilling oil passages in the crankshaft, which many constructors consider to be a formidable undertaking. On the strength of experience with previous engines, I have decided that a pump may safely be dispensed with, and that adequate lubrication can be obtained by simpler means, to supply all requirements for anything short of a highly-tuned racing engine.

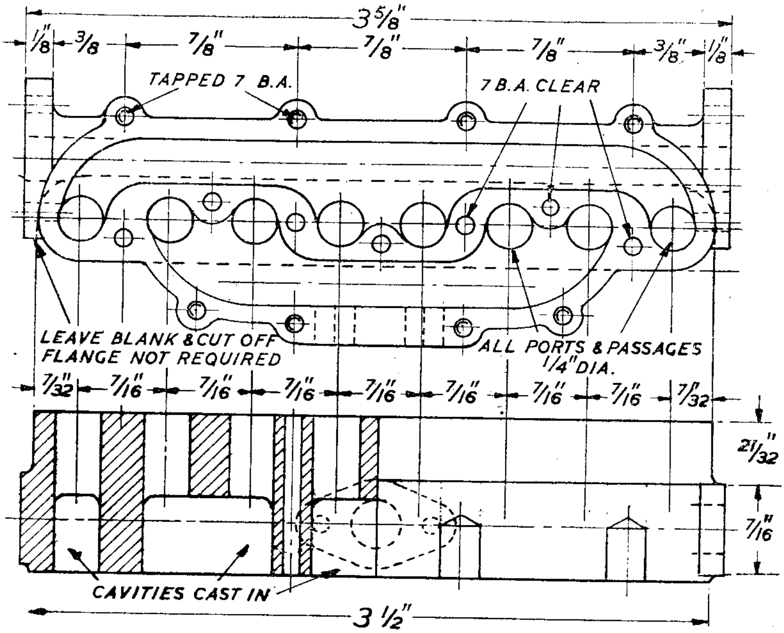


Fig. 33. *Inlet and exhaust manifold body casting*

Gravity systems of lubrication—often loosely referred to as "splash" lubrication—can be made to give quite good results, but are not quite

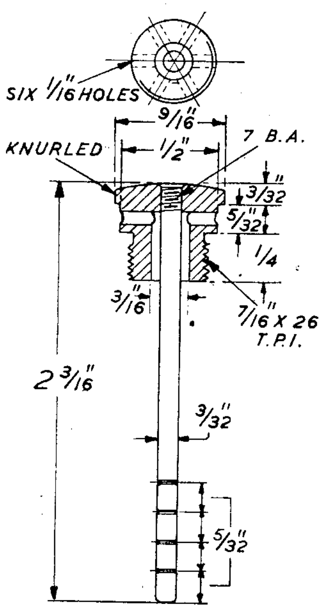


Fig. 32. *Breather and dipstick*

as simple as they appear on the surface. The basic form of splash lubrication, in which the base of the crankcase is filled with oil up to a level sufficiently high to allow the big-ends of the connecting-rods to dip in it, and thereby splash oil lavishly all over the working parts, is only practicable in engines which run at comparatively low speed—up to a few hundred r.p.m. At high speeds, the big-ends simply "cut a hole" in the oil, and rotate without picking up any appreciable quantity of it; thus one may encounter the paradoxical but not unprecedented condition of "starvation in the midst of plenty." Extending the rods to form dippers may make things worse instead of better, especially when scoops or impact ducts are used with the intention of conveying oil directly to the crankpin bearings. A further upsetting factor in an enclosed engine is the agitation of air inside the crankcase, which acts in the same manner as an Atlantic gale, to whip up the oil and destroy all semblance of a definite oil level. I have formed the conclusion that at anything above two or three thousand r.p.m., oil cannot exist in a true liquid form in the main crankcase of a small engine, but is scattered around in small drops and oil mist, with no chance to settle in the bottom for a moment.

It is, however, possible to arrange baffles in the crankcase so that the oil has a chance to settle in the sump without undue disturbance. This does not, however, solve the essential problem of getting oil to the bearings, unless some means is provided for continuously lifting it either to provide direct oil feed or spray. Many engines for motor cars and similar purposes have been fitted with a pump to pick up oil from the sump and fill troughs under each big-end bearing, which although being constantly emptied by the sweep of the moving parts, are

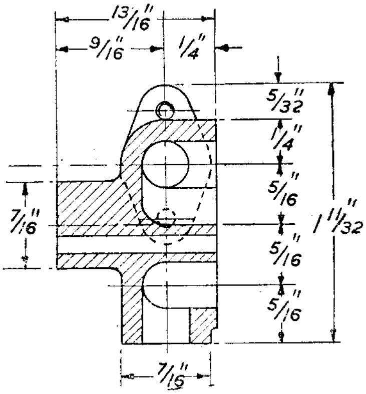


Fig. 34. *End section of manifold body*

as persistently refilled, so that oil is always present to provide the requirements of the splash lubrication system.

A still simpler version of the same idea consists of using gravity to effect continuous replenishment of oil in the troughs. The latter are made fairly deep and the sump is filled up to a fairly high level—it may even be above the top of the troughs without doing harm. Holes are provided in the bottom of each trough, so that when the engine is running, oil seeps up from below to take the place of that swept away by the movement of the cranks.

This method has been used by me in many small engines, and has been found to give extremely good results in practice, so that I have no hesitation in recommending it in the present case. Once again, it is an optional feature, and may be modified or elaborated as the constructor may desire, but in the form shown, it will satisfy normal requirements, except when the engine is required to run with the crankshaft axis considerably inclined to the horizontal plane.

The oil trough illustrated in Fig. 31, is designed to be fabricated from brass or copper sheet; a casting might be used, but offers few, if any, advantages, and the trough is so simple to make that it would hardly be worth while. It will be seen that partitions are fitted to the trough, each secured by a single rivet and sweated. The two feet by which the trough is mounted in the sump are extended and reduced in size to act as rivets for two of the partitions. A slot is cut in the centre partition to clear the dipstick, giving ample clearance, so that the latter is not liable to be scraped when it is lifted out to test oil level.

Fitting and Adjusting

The trough should be fitted so that it only just clears the big-ends, and the oil feed holes should be as nearly as possible under the centre of each crankpin. No details are shown in the sump drawing of the holes for the countersunk screws which secure the feet of the trough, but their position will be fairly obvious, and it may be mentioned that spot-facing on the inside of each hole is desirable, to provide a good surface for the feet, and avoid risk of oil leakage at this point. It will be necessary to tilt the sump sideways to get the trough in when assembling, but if any difficulty is experienced, the aperture in the bottom of the main casting may be widened, though it is not desirable to reduce the baffling effect of the rim more than is necessary.

Breather and Dipstick (Fig. 32)

Although no air is actually displaced by the pistons in the crankcase of a four-cylinder engine, ventilation of the crankcase is desirable and possibly necessary. The breather in this engine acts also as the oil filler cap, and also holds the dipstick. It is quite a simple and straightforward machining job, and is made preferably in light alloy, including the dipstick, though any other convenient material may be used. While the breather is set up in the lathe, after drilling, counterboring and tapping the centre, it is advisable to screw in the dipstick as tightly as possible; any tendency for it to run out of truth may then be detected and corrected. Six holes are drilled crosswise in the edge of the breather to act as air vents.

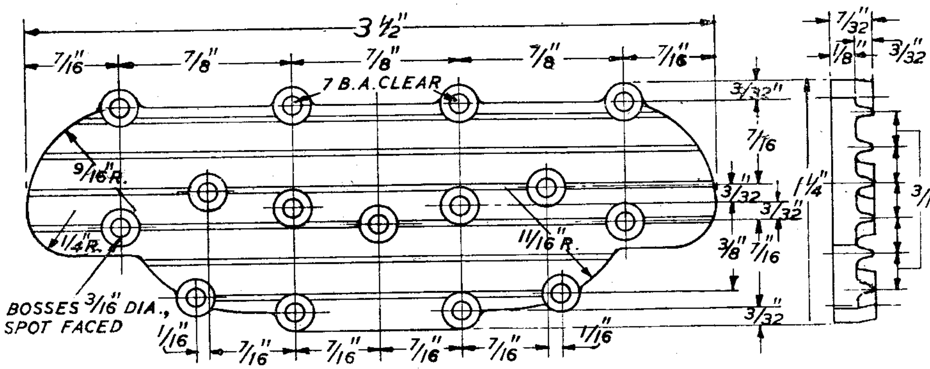


Fig. 35. *Manifold cover-plate*

The marks on the end of the dipstick should be very clearly defined, by turning narrow grooves

with a narrow vee-tool oil-stoned to a slight radius at the tip. These grooves, formed in this way, will hold oil long enough to take a reading, but not indefinitely, to show false indications. The positions of the marks are more or less arbitrary, but in the positions shown, it is suggested that the bottom mark is definitely a low-level danger point ; the next above it is the lowest level permissible in working, the next is normal level, and the top one highest permissible level. Needless to say, oil level readings should only be taken after the engine has been standing for a few minutes. If the breather shows any tendency to throw oil spray, this may be reduced by fitting a conical sleeve on the upper part of the dipstick, point downwards, and fairly close to the breather. Little trouble is, therefore, anticipated in this respect, as a result of experience with earlier engines.

Inlet and Exhaust Manifold

Among the many detail problems in the design of this engine, few have caused more headaches than that of the " plumbing," or manifold system. This has not been so much a matter of actual design, from the technical standpoint, as of ways and means of producing a satisfactory form of manifolding in a small size. There are, of course, many practical ways of fitting inlet and exhaust pipes to a small engine, one of the most obvious being the methods of the coppersmith, in the use of bent and branched pipes, either of copper or other suitable material. Such pipes provide excellent scope for the skill of the craftsman, and look very nice when properly executed ; but they are quite a problem if one's particular type of manipulative skill does not run in that direction, and are most decidedly an eyesore if not neatly made. Some experience in this respect has been obtained with the copper exhaust pipe of the " 1831 " engine, which appears to have worried a few constructors, though it is a much larger and less complicated job than a manifold for a 15-c.c. four-cylinder engine.

Not Representative

There were, moreover, other objections to the use of a pipework manifold on this engine ; for one thing, no modern four-cylinder engine of any type that I know of uses such a manifold. and thus it would not be representative of prototype practice. In addition, it would be quite a problem to arrange for the proper attachment of all the inlet and exhaust flanges, with reasonable accessibility of screws or nuts. I also wished to utilise the advantages of combining the inlet and exhaust manifolds, with the object not only of " hot-spotting " to compensate the refrigerating effect in the induction pipe, but also dissipating exhaust heat as well.

It was decided, therefore, to make the manifold in the form of a casting, in which passages were incorporated for both the exhaust and inlet systems. The first type of manifold designed was in a single piece, with an elaborate system of cores to form the two sets of passages ; this was extremely neat and compact, but nearly led to an unofficial strike of patternmakers and moulders when the drawings were produced. Quite apart from the difficulty of making the core boxes, and the cores themselves, the problem arose of ensuring perfectly accurate location of the cores under production conditions. Inaccurate placing of cores would not only result in a high percentage of scrap castings, but might in some cases remain undetected until the engine was finished, when a hitherto unsuspected leak between the exhaust and inlet passages would cause mysterious engine trouble.

Very reluctantly, the one-piece manifold design was scrapped, and the alternative type shown in detail in Figs. 33, 34 and 35 was produced. This is in two pieces, a main casting and a cover plate, bolted together so as to segregate the two sets of passages, which are cast in as grooves in the main casting, and thus require no core-box. In pursuance of my policy of making the engine design as adaptable as possible, provision is made for attaching the exhaust pipe at either end of the manifold, flanges being provided at either end, so that the one not required may be sawn away, and the casting faired up by filing to the same shape as the cover plate.

Simple Machining

The machining of these castings is extremely simple, consisting only of facing the joint surfaces and drilling the bolt holes ; but some care is necessary in locating the latter properly and ensuring that they pass quite squarely through the casting, as the amount of metal between the passages is necessarily restricted, and careless drilling may spell disaster. It is recommended that the joint faces should finally be lapped flat, and metal-to-metal joints used both between the two parts of the manifold, and between manifold and cylinder block. Fifteen screws or bolts are used in the manifold, those in the centre passing right through into the cylinder block, and those round the edge securing the cover plate to the manifold casting. The size specified is 7-B.A., but 3/32-in. Whitworth is equally suitable, and may be preferred for tapping in light alloy owing to the coarser thread.

If it is desired to obtain the best air flow efficiency in the passages, they may be cleaned up internally before attaching the cover plate, using rifflers, rotary files or dental burrs. The fairing off of angles or junctions between the drilled and cored passages, is the most important in this respect, and care should also be taken to see that the ports in the manifold line up with those in the cylinder block.

Carburettor—Either Way Up

The carburettor flange is on the underside of the manifold, and intended for the fitting of an " up-draught " vertical carburettor. It would, however, be practicable to invert the entire assembly, should the constructor have strong views on the merits of " down-draught " carburettors, as the type of carburettor I have designed for the engine would work either way up. But the elevation of the carburettor above the top of the engine does not strike me as being very desirable, neither do I see any great advantage in sucking air down instead of up.

(To be continued.)

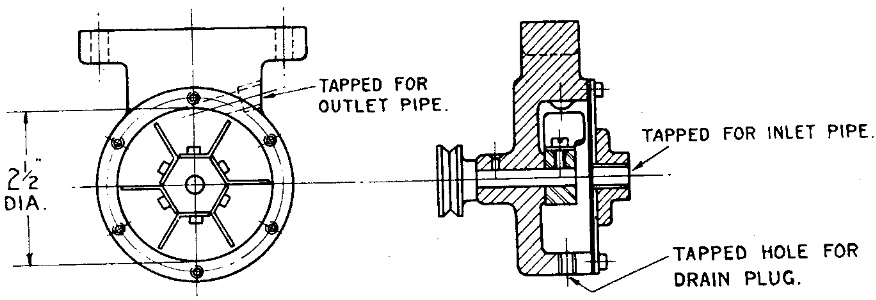
AN IMPROVED LUBRICANT SYSTEM FOR A SMALL LATHE

by J. A. Kidd

I AM in possession of a $3\frac{1}{8}$ in. Myford lathe and through the course of the work I have carried out I have done quite an appreciable amount of turning, boring, and milling etc. on mild steel components. This necessitated the use of a lubricant to improve the cutting action of the tool. Originally, I adopted the old method of paint brush and jam jar but I soon found this inconvenient, especially when screw-cutting, where both hands are required to operate the lathe gear. I decided to fix a drip can on the cross-slide to deliver the lubricant to the tool. This method proved satisfactory for plain turning and external screw-cutting but the can attached to the cross-slide was cumbersome and bulky and altogether the job called for something neat and compact which would take up minimum space and would deliver lubricant with sufficient head to get right to the tool and wash away the chips, especially when boring. This gave way to the design of the following system which has proved very effective and has been operating continuously for a long period free from any defects. The equipment consists of a tray under the lathe, a reserve tank for the lubricant, a small centrifugal pump, some lengths of $\frac{3}{8}$ in. dia. and $\frac{1}{4}$ in. dia. brass tubing, a short length of $\frac{3}{8}$ in. dia. bore rubber tube and a piece of $\frac{1}{4}$ in. dia bore rubber tube of a convenient length.

The tray was made from a piece of sheet metal of convenient size, the corners were cut out and edges turned up all round and then brazed at each corner. To avoid any leakage through the bolt holes I turned and drilled four bosses of identical thickness and sweated these to the top surface of the tray directly over the bolt holes. These bosses proved invaluable as they not only prevented leakage but raised the lathe off the surface of the tray, enabling swarf to be cleared away from inside the coring of the lathe bed. A drainage hole was drilled in the tray in a convenient position and a short length of 1 in. dia. tube soldered to the underside directly over this hole. A piece of wire gauge was secured over the hole to prevent anything except the liquid getting in the reserve tank.

I made the **reserve tank** from a varnish tin by piercing a hole in the base and sweating a boss to the underside. The boss was drilled and tapped to receive the screwed end of a piece of the $\frac{3}{8}$ in. tube. This tube was bent to give lead to the pump.



VIEW OF FRONT WITH PLATE REMOVED SHOWING ROTOR.

SECTION ON CENTRE LINE.

Fig. 1

The Pump (Fig. 1)

The pump is quite simple and effective. I was fortunate here in so far as I was able to obtain a casting off a wooden pattern I made. It is a simple matter however to make the pump out of a piece of $2\frac{1}{2}$ in dia. tube, $\frac{3}{4}$ in. long and turning 2 ends to fit the tube. The machining of the casting for the pump body was carried out by gripping the outside in a small 3-jaw chuck, the hole for the spindle of the rotor being drilled and reamed at the same setting as the turning of the inside and the facing of the side for the end plate. The casting was then turned round in the chuck and the boss on the outside faced to length. I then machined the base by means of a fly cutter in the chuck with the pump body clamped down on to the cross-slide. The outlet hole was then drilled and tapped and 2 holes drilled in the lugs on the base to secure the pump in position. I cut the end plate out of a piece of brass sheet about $\frac{1}{16}$ in. thick. A boss was sweated to the centre of this plate and then by gripping on the boss a hole was drilled through the centre of the plate and boss and tapped to receive the screwed end of the $\frac{3}{8}$ in. tube. The outside diameter of the plate was trued and turned to fit flush on the body of the pump. While the plate was in position in the chuck it was marked out for drilling.

The plate was secured to the face of the pump body by means of 6 Meccano screws (5/32 in Whit.) that I dug up, a packing washer being placed between to prevent leakage.

The rotor was built up by securing 6 blades

cut from thin brass plate on to the periphery of a hexagon boss by means of 6 Meccano screws the hexagon boss being drilled and tapped in each face to receive the screws. A hole was drilled and reamed in the centre of the hexagon to be a press fit for the rotor spindle which comprised a piece of $\frac{1}{4}$ in. dia. silver steel rod. For the hexagon centre I used the head of a $\frac{1}{2}$ in. set screw parting this off and drilling as stated. The outside diameter of the rotor was made to just clear the inside of the pump body. I turned a small pulley to fit on the projecting spindle of the pump assembly and upon drilling an oil hole in the bearing and a drain hole this completed the pump. On assembly the rotor revolved freely giving a good running fit in the bearing which is necessary to prevent leakage.

The System (Fig. 2)

In my particular case the lathe is secured on to a wooden bench. I fitted a board across the underside of the bench in a suitable position. The pump was fastened to the underside of this tray. The drain tube on the tray should be attached so as to come directly over the board under the bench. The reserve tank was then assembled on the board in a position directly under the drain tube. The pipe from the underside of the tank was then attached to the boss in the centre of the plate on the pump. A short piece of $\frac{3}{8}$ in. dia. tube was secured in the outlet on the pump body, this was connected by a piece of rubber pipe to a vertical tube passing through a hole in the top of the bench. This tube protruded about 8 in. above the bench and a union combining a tap was attached to the top. The lead from this union was a piece of $\frac{1}{4}$ in. dia. tube to which was attached the length of $\frac{1}{4}$ in. bore rubber pipe. The other end of this pipe was secured to the nozzle clamped by a small angle bracket on to the cross-slide in a convenient position.

The job was now ready for a trial run, so hoping for the best I poured about 2 pints of lubricant into the tank, opened the tap to the full extent and keeping my fingers crossed,

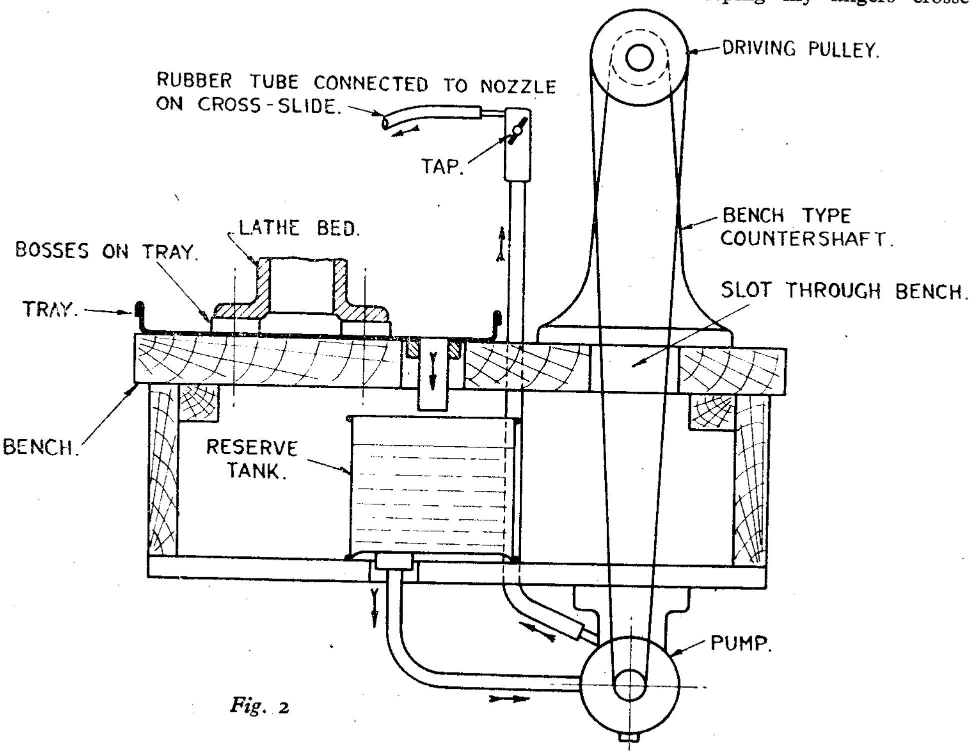


Fig. 2

board in a position convenient for the drive. The lathe is driven by way of a bench-type countershaft from a motor on the floor. I took advantage of this countershaft by increasing the length of the spindle and securing a pulley about 3 in. dia. to the extended portion of the spindle. A slot was cut through the bench to allow a round leather belt to be fitted round the pulley on the countershaft and that on the pump as shown. A hole was bored through the bench to clear the tube soldered to the underside of the switched on. Nothing happened for about 10 seconds and then the lubricant shot out of the nozzle faster than I expected, in fact it did not run back by way of the tray until I toned down the pressure with the tap. I gave it a good run and remedied several leaks.

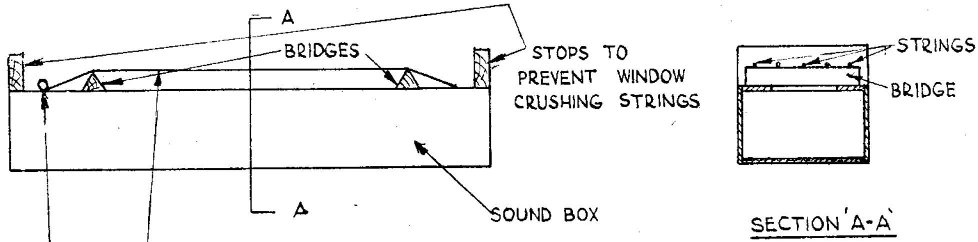
The system requires no attention except an occasional oiling of the pump bearing, and has proved a great asset when operating the lathe, apart from the pleasure I obtained in designing and manufacturing the parts.

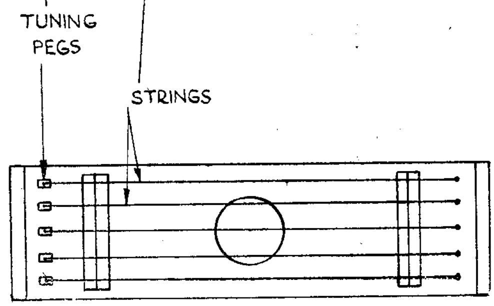
Editor's Correspondence

The Aeolian Harp

DEAR SIR,—I noticed an enquiry *re* Aeolian Harps in a recent issue of THE MODEL ENGINEER, and in turning over some old books the other day, I came across "The Boys Own Book" a complete encyclopedia of all the "diversions," which was published in a sixteenth edition in 1839 by Whitehead & Co., Fleet Street, London, and which contained the following paragraph under the heading "The Aeolian Harp."

"This instrument consists of a long narrow





box of very thin deal, about five or six inches deep, with a circle in the middle of the upper side of an inch and a half diameter, in which are to be drilled small holes. On this side, seven, ten, or more strings, of very fine gut, are stretched over bridges at each end, like the bridge of a fiddle, and screwed up, or relaxed, with screw-pins, where the wind can pass over its strings with freedom.

A window, of which the width is exactly equal to the length of the harp, with the sash just raised to give the air admission, is a proper situation. When the air blows upon these strings, with different degrees of force, it will excite different tones of sound; sometimes, the blast brings out all the tones in full concert, and sometimes, it sinks them to the softest murmurs."

From a woodcut at the head of the paragraph, I have prepared the reproduced sketch; and perhaps your enquirer may find this of some use in the construction of such an instrument.

It is an interesting reflection on our present-day rush and bustle that an Aeolian Harp could be looked on as a "diversion" only about 150 years ago!

Yours faithfully,

Liverpool. W. H. LAMBOURNE.

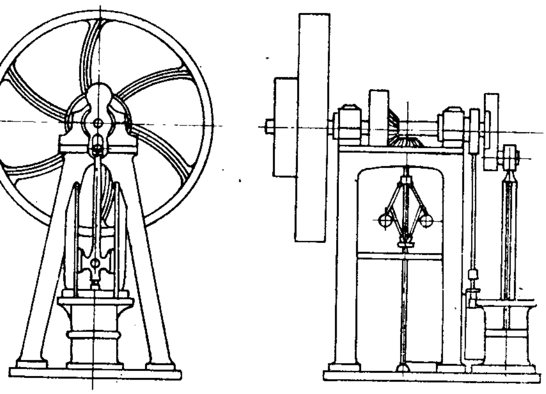
Baker Valve-Gear

DEAR SIR,—I thank Mr. Reynolds for his letter in your April 3rd issue. The points he raises are of the utmost interest and are, of course, fundamental to the functioning of the types of valve-gear with which model engineers are primarily concerned.

I think no *general* answer can be given to any one of the points Mr. Reynolds raises, as so much depends upon individual circumstances and conditions, but I would offer the following comments :—

(1) I believe the Stephenson gear (and possibly the Allen as well), properly designed and applied, to be the best gear yet devised for a locomotive. The gear as developed by the late Mr. Churchward and as used on all the G.W.R. outside-cylinder locos. including the new "1000" Class, would seem to be as near perfection as possible; this gear uses launch-type links and comparatively short eccentric-rods (these latter are a deliberate feature of the design, as there is ample room for long rods if they were desired) and it gives a considerable additional advance to the valve when the gear is moved from "full" towards "mid" position. The valves are set to give $\frac{3}{16}$ in. *negative* lead in full gear, for the excellent reason that unless they were, the lead towards mid-position would be far too great. The "theory" that negative lead means sluggish starting is being completely refuted every hour of the 24 all over the G.W. system by the "Halls," "Manors," "Saints," "Granges" and by the new "1000" Class. If anyone wants to see it refuted in model work, I recommend them to watch Mr. A. J. Maxwell's beautiful Maskelyne-designed 0-6-0 G.W.R. 5-in. gauge goods engine.

The great feature of this type of gear is that at short cut-offs, it gives a larger total port opening than does a gear of the Baker, Walschaerts or Joy type at equivalent cut-offs, and in consequence a bigger diagram, i.e. more cylinder power. With proper design and setting the increase in compression is not of serious consequence in an engine designed for high speeds.



Elevtions of the old steam engine in Lancashire

Professor Sauvage, the eminent French locomotive engineer, has a saying, "The greater the lead the slower the start."

(2) The best ratio between "lap" and "lead" is quite possibly neither the 6-to-1 of the "Lady of the Lake" nor the 13-to-1 of G.W.R. practice (for Walschaerts gear only).

It is quite likely much higher for really high-speed work, and I believe that in France as much as 40-to-1 has been tried with success; one thing, however, is, in my opinion, certain, and that is that the G.W.R. 13-to-1 is infinitely better than the old L.N.W.R. 6-to-1. As regards exhaust clearance, again in my opinion, it is both unnecessary and undersirable. If it is not found necessary in full-size practice where piston speeds may rise to 2,000 ft. per min., how much less is it where they rarely rise to 1/10th of this figure. As Mr. C. Keiller and both the late H. Greenly and the late G. S. Willoughby have remarked in the past, the necessity for exhaust clearance in a valve is an admission, maybe unconscious and certainly unintentional, of faults elsewhere in the system.

Lastly (3) I think the answer here again is conditional, not so much on the question of principle as on the question of implementation. I think there is little doubt that the "Reikie" arrangement in particular, and the Walschaerts, J. T. Marshall and Baker gears in a lesser degree do have a beneficial effect on valve events as compared with the simple harmonic movement given by an eccentric directly operating the valve through a long rod. It boils down to the question of how much additional complication (and if full-sized work, of course, cost) liability to wear, etc., we are prepared to accept to obain a slightly improved steam distribution.

For any small stationary type of engine working at a constant load, I regard the simple excentric drive as ideal; if one desires to work at an early cut-off, fit an additional cut-off valve of the Meyer type operated by a second eccentric. I am just completing a large-scale "diagram" model of a Baker gear, 2 in. scale with a view to studying its characteristics, and if Mr. Reynolds is in this district at any time, I would be very glad to show it to him.

There is one point about Baker gear which may account for its declining popularity in its home, and possibly for the fact that it has never been adopted in this country; and that is that the specific loadings on certain of the joint-pins come out very high, even when operating piston valves; naturally, with unbalanced slide valves these loadings must be higher still. The idea that the fact that it has not been adopted in Britain is due to the perverseness, obstinacy and unprogressive attitude of British locomotive engineers in general, is too futile to need consideration.

A thing about Baker gear, in common with any other single-eccentric (or return-crank) gear; it is subject to serious errors in distribution if an unduly short eccentric-rod is used; the length of this should never be less than $3\frac{1}{2}$ times the travel of the return-crank, and preferably more.

Yours faithfully,

Wealdstone, K. N. HARRIS.

An Old Steam Engine

DEAR SIR,—In the ruins of an old mill at Norden, near Rochdale, there is an old steam engine which has been left rotting away with five others, and a Lancashire boiler.

The bed of this engine was like a table, cast with the top and legs in one piece and bolted down to a cast-iron bedplate, which in turn is bolted to a slab of concrete. The height of the table is 4 ft. 6 in., and the top of the table measures 2 ft. $4\frac{1}{2}$ in. by 1 ft. $5\frac{1}{2}$ in.

The flywheel is 4 ft. 3 in. diameter by 5 in. face. There are six curved spokes of + section.

The cylinder is bolted direct to the bedplate by its bottom flange. The bore is approximately 9 in. and the stroke 13 in.

The crosshead is of the alligator-type and runs between locomotive-type slide bars, which are 2 ft. $3\frac{1}{2}$ in. long by $2\frac{1}{4}$ in. wide.

The connecting-rod is bellied and has strap and cotter big- and little-ends. The centres of the connecting-rod are 2 ft. 1 in.

The crankshaft is $2\frac{1}{2}$in. diameter and rests in two bearings, one at each end of the table; the single crank web is balanced.

The governor has two 5-in. diameter balls and was driven direct off the crankshaft by bevel gears to the tops of the governor spindle. I have no idea of the age, origin, speed or working pressure of this engine, but probably some reader could throw some light on the matter.

Yours faithfully,

Shaw, Lancs. S. LEES.